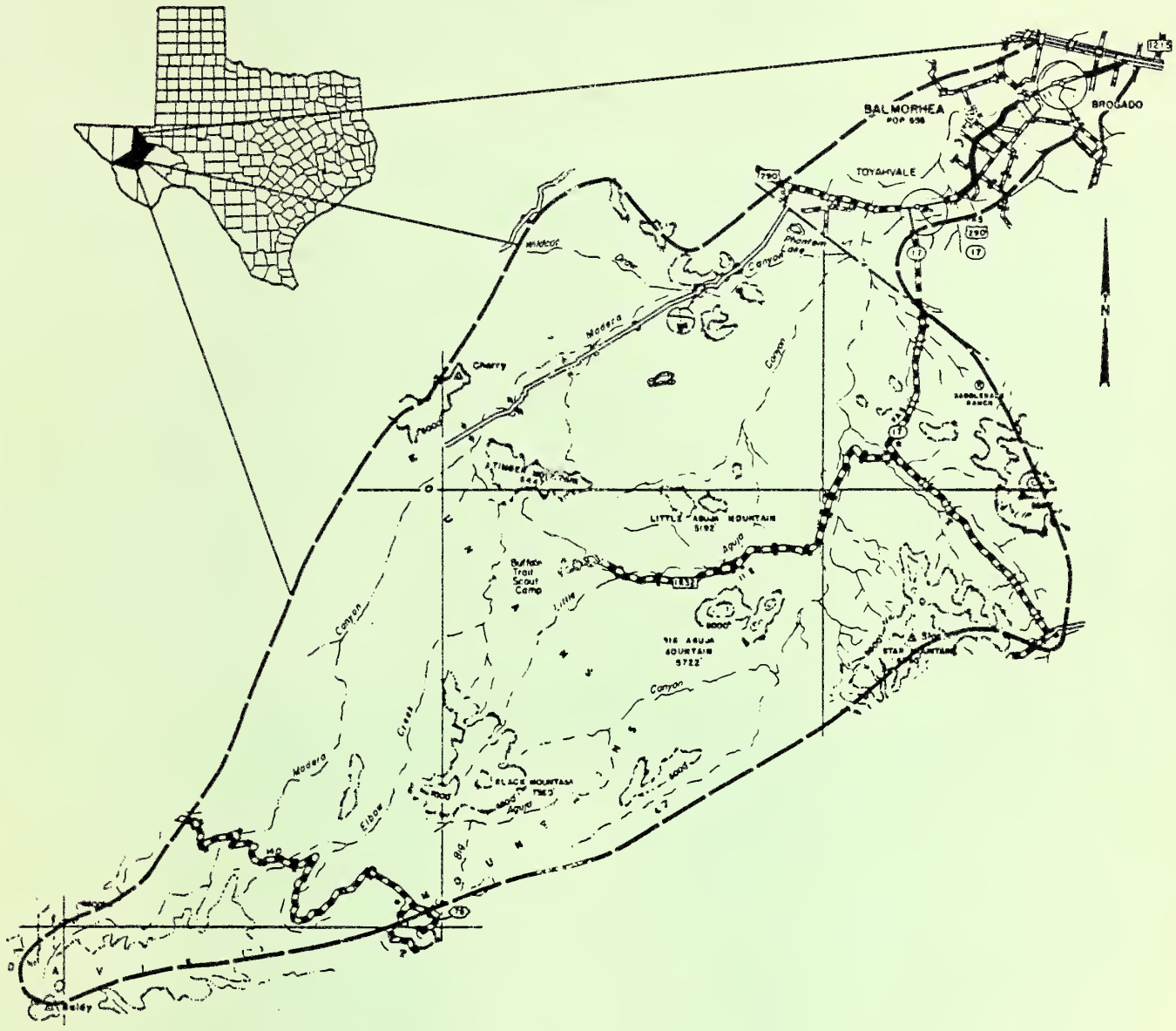
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS



Prepared by
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Temple, Texas
In cooperation with
TOYAH-LIMPIA SOIL AND WATER CONSERVATION DISTRICT
REEVES COUNTY COMMISSIONERS COURT
REEVES COUNTY WATER IMPROVEMENT DISTRICT NO. 1
CITY OF BALMORHEA
and the
TEXAS WATER COMMISSION
JULY 1986

TOYAH CREEK

FLOOD PLAIN MANAGEMENT STUDY

REEVES COUNTY, TEXAS

Prepared by

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
W. R. Poage Federal Building
101 South Main
Temple, Texas 76501-7682

In Cooperation With

TOYAH-LIMPIA SOIL AND WATER CONSERVATION DISTRICT [et al.]
REEVES COUNTY COMMISSIONERS COURT
REEVES COUNTY WATER IMPROVEMENT DISTRICT NO. 1
CITY OF BALMORHEA
and the
TEXAS WATER COMMISSION

JULY 1986

FLOOD PLAIN MANAGEMENT STUDY

TOYAH CREEK

REEVES COUNTY, TEXAS

TABLE OF CONTENTS

	Page
INTRODUCTION	1
DESCRIPTION OF STUDY AREA	4
NATURAL VALUES	6
Prime Farmland Soils	7
Wetlands	7
Fish and Wildlife Habitat	7
Threatened and Endangered Species	8
FLOOD PROBLEMS	9
EXISTING FLOOD PLAIN MANAGEMENT	10
ALTERNATIVES FOR FLOOD PLAIN MANAGEMENT	13
Present Conditions	13
Land Treatment	13
Preservation and Restoration of Natural Values	13
Nonstructural Measures	14
Structural Measures	17
Selected Alternative	18
FLOOD HAZARD MAPS	18
TECHNICAL APPENDIX	19
GLOSSARY	22
BIBLIOGRAPHY	27

INTRODUCTION

This flood plain management study report identifies areas of flood plain subject to flooding by Toyah Creek and Sandia Creek within the city of Balmorhea and vicinity, Reeves County, Texas.

The assistance and cooperation given by the agencies, organizations and individuals during the Toyah Creek Flood Plain Management Study is greatly appreciated. These include:

-- Toyah-Limpia Soil and Water Conservation District
-- City of Balmorhea
-- Reeves County Commissioners Court
-- Reeves County Water Improvement District No. 1

Special appreciation is extended to the individuals who contributed information for the study. Appreciation is also extended to the landowners who permitted access to their property for surveys, photographs, and reconnaissance.

The city of Balmorhea is located in the flood plain of Toyah Creek. It is also within the local irrigation district, Reeves County Water Improvement District No. 1.

In March 1967, the Soil Conservation Service made a preliminary investigation of the Madera Canyon Watershed which drains into Toyah Creek to determine the feasibility of a PL-566 watershed project to reduce flooding along Toyah

Creek. The SCS found during this investigation that Toyah Creek overflows an average of once every 3 years and that a major flood occurs about every 9 years in the irrigated area of the flood plain. The 1967 investigation report states, "major floods have caused damage to crops, farm irrigation systems, main and lateral canals, fences, county roads, highways, bridges, the diversion dam and diversion canal, and Lower Parks Reservoir. In addition, floods which occurred in 1932, 1941, 1945, 1955 and 1963 caused damage to urban properties in Balmorhea. At the present level of development, about 25 to 30 houses would be flooded from the recurrence of a flood similar to that which occurred in 1932. This flood is estimated to be about a 25 year frequency event."

Since the 1967 investigation, additional floods occurred in 1968 and 1974. There are presently 205 city residences, 28 rural residences and 12 units of low income housing located within the Toyah Creek flood plain. Also, there are 10 businesses and 4 buildings comprising the Balmorhea Public School. The Balmorhea State Park and Recreation Area with 12 cabins and 2 park employee residences are located in the Toyah Creek flood plain. There are approximately 35 farms consisting of 20 acres or more and a total of approximately 5,000 irrigated acres within the flood plain. Since most of the city of Balmorhea is in the flood plain, most future development will occur within the Toyah Creek flood plain.

The city of Balmorhea is presently in the emergency flood insurance program; however, no detailed flood insurance study has been made.

This study was requested by the City of Balmorhea, the Toyah- Limpia Soil and Water Conservation District, Reeves County Commissioners Court, Reeves County

Water Improvement District No. 1, and the Texas Water Commission in order to obtain a factual basis for reducing future flood damages and flood hazards through carefully considered and well planned local regulations and use of the flood plain.

The study was conducted according to the April 1983 Plan of Work developed and endorsed by the above named requesting entities and the Soil Conservation Service (SCS).

The SCS conducts cooperative flood plain management studies in Texas through the November 1973 Joint Coordination Agreement (Revised 10/30/78) between the SCS and the Texas Department of Water Resources [1/]. SCS assists state agencies and communities in the development, revision, and implementation of their flood plain management programs by carrying out cooperative flood plain management studies (FPMS's) in accordance with Federal Level Recommendation 3 of "A Unified National Program for Flood Plain Management," and Section 6 of Public Law 83-566. The principles contained in Executive Order 11988, Flood Plain Management, are addressed in this part.

Topographic data for this study were obtained from field surveys and Geological Survey topographic maps. Rainfall frequency data were obtained from Weather Bureau Technical Paper No. 40, Rainfall Frequency Atlas of the United States. Peak discharge values were determined by flood routing various storm frequencies with a 24-hour rainfall duration using SCS Technical Release No. 20, A Computer Program for Project Formulation, Hydrology. Water surface

---

1/ Changed to Texas Water Commission in 1985 by the 69th Texas Legislature.

profiles were developed by the Modified Slope Area Method using SCS Technical Release No. 61, WSP2, A Computer Program for Determining Flood Elevations and Flood Areas for Certain Flow Rates.

DESCRIPTION OF THE STUDY AREA

The study area includes the lower reach of Madera Canyon, Toyah Creek and the part of Sandia Creek affected by the overflow from Toyah Creek. The study area is in Geological Survey Hydrologic Unit Number 13070003. The study area watershed is in the Water Resources Council Rio Grande Region, Subregion 07, and Pecos River Basin.

Madera Canyon heads approximately 34 miles southwest of Balmorhea at the McDonald Observatory in the Davis Mountains, Jeff Davis County, and flows in a northeasterly direction toward Balmorhea. Madera Canyon confluences with Toyah Creek in Reeves County approximately 5.5 miles southwest of Balmorhea. Toyah Creek flows in a northeasterly direction through the city of Balmorhea. The study limit terminates approximately 2.3 miles northeast of the Balmorhea city limits. The total drainage area of the study area is 285.0 square miles or 182,400 acres.

The city of Balmorhea and the unincorporated communities of Toyahvale and Brogado are located within the study area. The 1980 census gives the population of Balmorhea as 568 and Toyahvale as 60. No population figures are listed for Brogado, but local officials estimated its population to be 100.

The Index and Study Area Map, Appendix, page 7, shows the streams and areas studied. The total channel length of stream reaches that were studied in detail is 12.6 miles. This includes Toyah Creek, 10.8 miles and Sandia Creek, 1.8 miles.

The study area watershed has a semiarid climate with moderate temperatures. The Reeves County portion of the study area has mild winters with a January average minimum temperature of 32 degrees Fahrenheit. The July average maximum temperature is 94 degrees Fahrenheit. The mean annual rainfall is 11.99 inches. The average growing season is 226 days.

The Jeff Davis County portion of the study area includes areas in the Davis Mountains. Climate, rainfall and temperature are variable in this area because of variation in elevations which range from about 3,200 feet to more than 8,000 feet. Generally, rainfall increases with altitude whereas temperature decreases. Rainfall average is about 2 inches higher and the temperature average is about 3 degrees Fahrenheit lower for each 1,000-foot increase in altitude. The average annual rainfall varies from over 18 inches in the higher elevations to 12 inches at the lower elevations. The average growing season varies from 209 to 226 days.

The study area is in the Trans-Pecos Land Resource Area.

NATURAL VALUES

The Toyah Creek Flood Plain Management Study is located in the western part of the state in the Trans-Pecos, Mountains and Basins Vegetational Area as described by F.W. Gould in his publication entitled, Texas Plants -- A Checklist and Ecological Summary.

The study area varies from desert valleys to mountain slopes. Since the elevation ranges from 3,100 to 8,000 feet and the rainfall varies from 12 to 18 inches, the diversity of elevation and rainfall allows a variety of plant communities to exist.

The land use in the study area is primarily rangeland in the upper reaches of the watershed with cropland and pastureland in the valleys around the town of Balmorhea.

There are approximately 5,000 acres of cropland in the study area, but only half is cultivated at one time because of the limited irrigation water. Major crops grown are forage sorghum, grain sorghum and cotton. A minor portion of cropland is being converted to pecan orchards. None of the cropland is considered to be prime farmland soils, because these soils are subject to wind erosion.

Approximately 300 acres of pastureland are in the study area. The primary pasture grass is coastal bermuda with some Jose wheatgrass. These grasses are also being irrigated.

Rangeland in the study area is covered with woody vegetation. It encompasses numerous vegetative types which vary according to elevation and rainfall. The major ones according to Gould's publication include creosote-tarbush, desert shrub, grama grassland, yucca and juniper savannahs. Saline range sites support saltbush, saltcedar, alkali saccaton and other salt tolerant plants.

Some forest associations occur in the upper reaches of the watershed at the higher elevations in the mountainous area. Major species in these assocations are oak, pinon pine and ponderosa pine.

The land use in the 500-year flood plain is as follows:

LAND USE	Percent	Acres
Cropland	35	1,916
Pastureland	4	219
Rangeland	55	3,021
Urban land	6	318

PRIME FARMLAND SOILS

No prime farmland soils have been identified in the study area.

WETLANDS

No wetlands as described in U.S. Fish and Wildlife Service's Circular 39, are located in the watershed.

FISH AND WILDLIFE RESOURCES

The fishery resources in the study area are comprised of Balmorhea Lake, small livestock water impoundments, and "potholes" in streams. Principal species of

fish in these resources are largemouth bass, channel catfish, and various species of sunfish and minnows.

The wildlife resources in the study area are as varied as the vegetative complexes.

Native game species include mule deer, white-tailed deer, javelina, scaled quail, gambrel quail, harlequin quail, and mourning dove. Aoudad sheep, an exotic game species, have been introduced in the area.

Predator species found in the study area are mountain lion, bobcat, coyote and various species of raptors. Furbearers include raccoon, ringtail, desert fox, gray fox, and badger.

Other species include cottontail, jack rabbit, and numerous species of rodents and songbirds.

THREATENED AND ENDANGERED SPECIES

The study area is in the range of occurrence of three endangered species as designated by the U.S. Fish and Wildlife Service. These endangered species are American Peregrine falcon (Falco peregrinus anatum), Commache Spring pupfish (Cyprinodon elegans) and Pecos Gambusia (Gambusia noblis). The falcon may nest in the mountainous area of the study area. The pupfish is found in Reeves County-Balmorhea State Recreation Area (San Solomon Springs) and vicinity and in Jeff Davis-Phantom Cave Spring and connecting canals. The Pecos Gambusia occurs in Reeves and Jeff Davis Counties. In Reeves County, it occurs in the springs and irrigation ditches around Toyahvale. In Jeff Davis County, it occurs in Phantom Cave Springs and vicinity.

FLOOD PROBLEMS

Floods from Toyah Creek and Sandia Creek damage residences, businesses, other buildings, streets and highways in the city of Balmorhea and vicinity. Irrigated cropland and irrigation ditches and canals are also damaged by these floods.

In addition to the areas affected by overbank flooding from Toyah Creek and Sandia Creek, other areas are affected by minor or nuisance type flooding from local runoff water.

Potential flood heights for 100-year and 500-year floods photographed at various locations to illustrate the flood problems are shown on page 11 (Figures 1 and 2).

Following is a tabulation of the acreages of rural and urban areas subject to inundation by the 100-year and 500-year floods.

FLOODED AREAS
TOYAH CREEK STUDY AREA

	Rural (Acres)	Urban (Acres)	Total (Acres)
Within the 100-year frequency flood plain	4,823	315	5,138
Within the 500-year frequency flood plain	5,156	318	5,474

Upstream flood plain and watershed land use changes anticipated by local officials within the next 10 to 15 years are not expected to significantly affect future flood elevations on the flood plains of the study area.

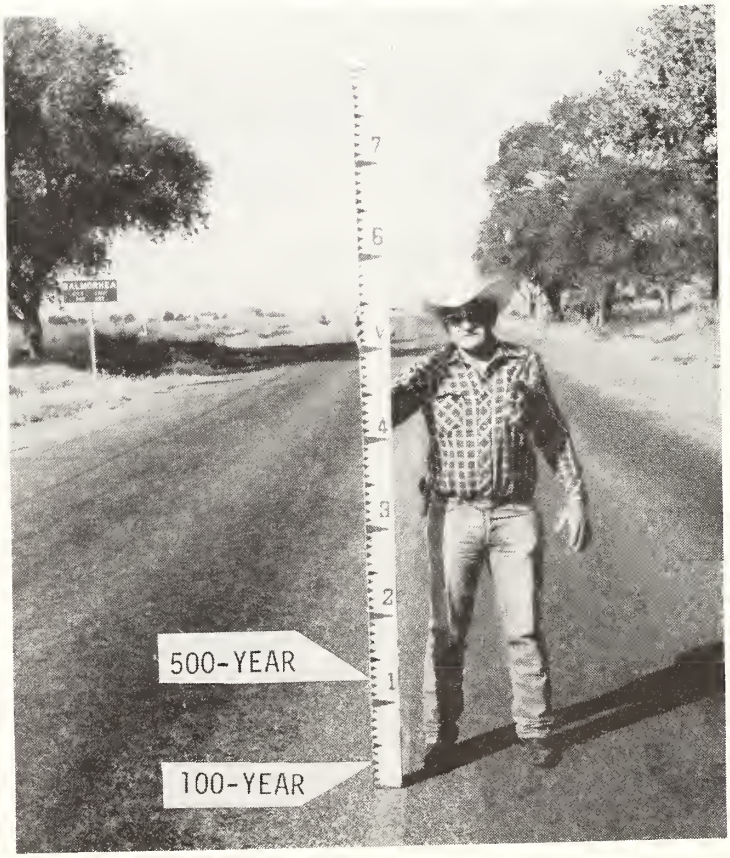
EXISTING FLOOD PLAIN MANAGEMENT

The 61st Texas Legislature in 1969 enacted the Texas Flood Control and Insurance Act, Article 8280-13 VACS, and Article 1581e-1 VACS. Article 8280-13 named the Texas Water Development Board and the State Board of Insurance as the responsible state-level agencies in respect to the National Flood Insurance Program. In 1985, the 69th Texas Legislature created the Texas Water Development Board and the Texas Water Commission from the Texas Department of Water Resources. Article 8280-13 was codified in Texas Water Code (Subchapter I, Section 16.311), and responsibility for the flood insurance program in Texas was assigned to the Texas Water Commission and the State Board of Insurance. Subchapter I, Section 16.315 of the Code authorizes all political subdivisions, including cities, counties, and many types of special purpose districts and authorities, to take all necessary and reasonable actions to comply with the requirements and criteria of the National Flood Insurance Program.

At the present time, state-level statutory controls on use and management of flood hazard areas are fairly limited. Subchapter G, Section 16.236 of the Texas Water Code requires the Texas Water Commission or the local political entity to approve plans for any levee or other such improvement which may change floodflows of any stream in Texas that is subject to floods. Also, in December 1977, Governor Briscoe issued Executive Order No. 34-A calling for state agencies to implement a flood plain management program for state-owned property and

Figure 1 -- Potential flood heights in front of SCS office on Dallas Street.

Figure 2 -- Potential flood heights at cross section 10, station 2041, at center of U.S. highway 290.



facilities. This state program will utilize state agency rules and regulations calling for evaluation of flood hazards and will conform to the minimum flood plain management criteria established by the U. S. Department of Housing and Urban Development for the National Flood Insurance Program.

ALTERNATIVES FOR FLOOD PLAIN MANAGEMENT

PRESENT CONDITIONS

Residences, businesses and public buildings are presently located within the study area flood plain and additional development is underway. Since flood hazard area maps have not been available prior to this study, the flood plain has been developed with very little regard to possible future flood damage.

LAND TREATMENT

Effective conservation land treatment is presently being carried out by land users in the watershed. Excess runoff or erosion and sedimentation due to lack of conservation land treatment is not a major cause of flooding.

PRESERVATION AND RESTORATION OF NATURAL VALUES

Since the primary natural value of the study area flood plain is its ability to transport floodwaters, encroachment onto the flood hazard areas of the flood plain with obstacles which interfere with the movement of floodwater should be avoided to preserve its present flowage capacity.

The woody areas along the streambanks in the flood plain are considered important environmental corridors and wildlife habitat. Provisions should be made to protect these woody areas in the planning and development of new urban areas.

No soils in the study area have been identified as prime farmland. Information on soils in the study area may be obtained from the Soil Conservation Service Office at Balmorhea, Texas.

NONSTRUCTURAL MEASURES

Nonstructural measures which will help reduce or minimize flood losses include flood proofing, flood warning systems, relocation, zoning regulations, participation in the national flood insurance program, emergency preparedness, and building or development codes.

Flood proofing can reduce flood damages by a combination of structural provisions and changes or adjustments to properties subject to flooding. Examples of flood proofing are sealing low window and door openings and modifying floor drains to prevent the entrance of flood waters.

Flood warning systems should be coordinated with local disaster plans. The National Weather Service issues warnings of potential flood producing storms. Staff gages set at key locations can be monitored to give advance warnings. A float-activated electronic signal could be connected to the local police or fire station for monitoring.

Relocation involves permanent evacuation of developed areas subject to inundation, acquisition of lands by purchase, removal of improvements and relocation of the population from such areas. Such lands could be used for parks or other purposes that would not suffer large damages and would not interfere with floodflows.

Zoning is a legal method used to implement and enforce the details of the flood plain management program, to preserve property values, and to achieve the most appropriate and beneficial use of available land. Clear, concise, and thorough zoning bylaws with enforcement of the bylaws are essential to make zoning effective.

Flood insurance was established by the National Flood Insurance Act of 1968 (Public Law 90-448, as amended) to make limited amounts of flood insurance, which were previously unavailable from private insurers, available to property owners and occupiers. The Flood Disaster Protection Act of 1973 (Public Law 93-234, as amended) was a major expansion of the National Flood Insurance Program.

Flood insurance is available through local insurance agents and brokers only after a local governing body applies and is declared eligible for the program by the Federal Insurance and Hazard Mitigation Division of the Federal Emergency Management Agency (FEMA). Adoption and enforcement of a local flood prevention ordinance which meets FEMA minimum flood plain management criteria is necessary to qualify and maintain eligibility.

In those communities participating in the FEMA program, owners and occupiers of all buildings and mobile homes in the entire community are eligible to obtain flood insurance coverage. Where flood insurance is available, it is recommended that buildings and mobile homes within or adjacent to the delineated flood hazard areas carry flood insurance on the structure and contents.

Emergency preparedness consists of a plan by local officials to be put into effect in the event of flooding. Procedures are worked out and personnel designated to implement the plan. Methods and procedures to alert and warn the populace of possible flooding are developed. High risk areas, handicapped, elderly or others known to need help during evacuation are located and identified. Plans are made for their evacuation or rescue. Shelters are provided for evacuees.

Building codes are developed to set up minimum standards for controlling the design, construction, and quality of materials used in buildings and structures within a given area to provide safety for life, health, property and public welfare. Building codes can be used to minimize structural and subsequent damages resulting from inundation. Building restriction codes can:

1. Specify adequate anchorage to prevent flotation of buildings from their foundations.

2. Establish basement elevations and minimum first-floor elevations in accordance with potential flood heights.

3. Prevent virtually all damage by elevating the foundation and prohibiting basements in those areas subject to very shallow and frequent flooding.

4. Require building reinforcement to withstand water pressure or high velocity flow and restrict the use of materials which deteriorate rapidly in the presence of water.

5. Prohibit equipment that might be hazarous to life when submerged. This includes chemical storage, boilers, and electrical equipment.

Development policies which are designed to prevent construction of streets and utility systems in flood prone areas tend to slow development of the flood plains.

STRUCTURAL MEASURES

In the March, 1967 SCS preliminary investigation of the Madera Canyon Watershed which drains into Toyah Creek, three floodwater retarding sites were located and evaluated to determine the feasibility of a PL-566 watershed project to reduce flooding along Toyah Creek. It was found during this investigation that the benefit-cost ratio of these three sites was not sufficient to be economically feasible.

As an alternative, during this flood plain management study, a single large site was evaluated to determine its effect on Toyah Creek flooding. Although such a structure would provide a considerable amount

of flood damage reduction, it was found that a single site large enough to meet the required design criteria will exceed SCS authority to design and construct. For this reason, no detailed evaluation of the site was made.

SELECTED ALTERNATIVE

The alternative for reducing flood losses selected by the city of Balmorhea for immediate implementation is to contact the Federal Insurance and Hazard Mitigation Division of the Federal Emergency Management Agency (FEMA) and apply for inclusion in the Regular National Flood Insurance Program. The City will adopt and implement the flood plain management ordinances necessary to qualify for and maintain eligibility in the Regular National Flood Insurance Program.

FLOOD HAZARD MAPS

The index map (Appendix, page 7) shows the stream reach covered by each of the photomaps. The index map also shows the watershed boundaries and stream reaches studied.

The limits of the 100-year and 500-year frequency floods, for present conditions, were delineated on aerial photographs (Appendix, pages 9 to 67) to indicate the extent of area inundated. The 10-year and 50-year frequency floods for present conditions could not be effectively shown

on the aerial photographs due to the map scale and topography. The flood lines shown are based on field surveys of roads, bridges, and valley sections used in conjunction with Geological Survey topographic maps having 20-foot or 10-foot contour intervals, and interpretation of aerial photographs. These maps should only be used to determine the approximate boundaries of the flooded areas. Actual dimensions measured on the ground may vary slightly from those measured on the photomaps of this report due to map scale and reproduction limitations. The water surface profile elevations should be used to determine actual on the ground dimensions.

Flood elevations in this report are minimum elevations. Debris may collect at bridges and culverts and clog the channels during major floods and increase the depth of flooding. Analyses were made without showing the effects of potential obstructions. Also extremely rare events such as catastrophic storms were not analyzed.

TECHNICAL APPENDIX

A technical appendix is included in this report. The index map, flood hazard area photomaps and flood profiles are included in the Appendix. The index map shows the study area coverage of individual flood hazard area maps and the watershed boundaries (Appendix, page 7).

The water surface profiles of Toyah Creek and Sandia Creek show the profiles of the 10-year, 50-year, 100-year, and 500-year frequency floods for present

conditions. Included on the profiles are stream elevations of the channel bottom, pertinent bridge and roadway data, and other location data. The stationing of profile is bank full stream channel distance in feet and is based on measured distances from the 1967 flight of aerial photomaps. Flood depths can be estimated at any location on the stream reach from the water surface profiles. The water surface profiles are included in the Appendix, pages 69 to 97. They consist of Toyah Creek, pages 69 to 93, and Sandia Creek, pages 95 to 97. An index is included in the Appendix page 5, to assist the user in relating the flood hazard area photomaps to the appropriate water surface profile.

Cross sections, representative of the streams studied, have been plotted to illustrate the shape of that stream and its flood plain. The 10-year, 50-year, 100-year, and 500-year floodwater surface elevations are shown on the plotted cross section to illustrate the effect of various flood depths (see Appendix, pages 99 to 101).

The elevations, discharges and flood plain width of the 10-year, 50-year, 100-year and 500-year floods at surveyed cross sections are shown in Appendix Table 2. Each cross section is listed by number on this table. Each cross section is also identified by number on flood hazard area photomaps. The user can locate a cross section on the photomap, turn to Table 2, (Appendix, pages 103 to 104) and read the discharge, elevation, and flood plain width directly from the table.

Also, included in the Appendix is a list of elevation reference marks showing the elevation and location of each. Additional data are on file in the USDA Soil Conservation Service State Office, W.R. Poage Federal Building, 101 South Main Street, Temple, Texas 76501-7682.

GLOSSARY

Channel -- A natural stream that conveys water; a ditch or channel excavated for the flow of water.

Channel Bottom -- The elevation of the deepest part of a stream channel at a particular cross section.

Channel Modification -- The modification of the flow characteristics of a channel by clearing, excavation, realignment, lining, or other means to increase its capacity; sometimes used to connote channel stabilization.

Flood -- An overflow or inundation that comes from a river or other body of water and causes or threatens damage.

Flood Frequency -- A means of expressing the probability of flood occurrences as determined from a statistical analysis of representative stream flow or rainfall and runoff records. A 10-year frequency flood would have an average frequency of occurrence in the order of once in 10 years (a ten percent chance of being equaled or exceeded in any given year). A 50-year frequency flood would have an average frequency of occurrence in the order of once in 50 years (a two percent chance of being equaled or exceeded in any given year). A 100-year frequency flood would have an average frequency of occurrence in the order of once in 100 years (a one

percent chance of being equaled or exceeded in any given year). A 500-year frequency flood would have an average frequency of occurrence in the order of once in 500 years (a 0.2 percent chance of being equaled or exceeded in any given year).

Flood Peak -- The highest value of the stage or discharge attained by a flood, thus, peak stage or peak discharge.

Flood Plain -- 1. Nearly level land situated on either or both sides of a channel which is subject to overflow flooding. 2. Lowland and relatively flat alluvial areas adjoining inland and coastal waters (streams, bays, etc.), including flood-prone areas of off shore islands.

500-Year Flood Plain -- The land that would be flooded on an average of once every 500 years.

100-year Flood Plain -- The land that would be flooded on an average of once every 100 years.

Flood Profile -- A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage -- The stage at which overflow of the natural banks of a stream begins to cause damage in the reach in which the elevation is measured.

High Water Mark (HWM) -- The maximum observed and recorded height or elevation that floodwater reaches during a storm, usually associated with the flood peak. The high water mark may be referenced to a particular building, bridge or other landmark, or based on debris deposits on bridges, fences, or other evidence of the flood.

Low Bank -- The highest elevation of a specific channel cross section at which the water will be contained without overflowing onto adjacent flood plain areas.

Runoff -- That portion of the precipitation on a drainage area that is discharged from the area in stream channels; types include surface runoff, groundwater runoff, or seepage.

Structural Bottom of Opening -- The lowest point of a culvert or bridge opening with a constructed bottom through which a stream flows that could tend to limit the stream channel bottom to that specific elevation. This structural bottom may be covered with sediment or debris which further restricts the size of the opening.

Top of Opening -- The lowest point of a bridge, culvert, or other structure over a river, stream or watercourse that limits the height of the opening through which water flows. This is referred to as "low steel" or "low chord" in some regions.

Water Surface Profile -- A graph showing the relationship of water surface elevation to stream channel location for a specific flood event.

Watershed -- All land and water within the confines of a drainage divide.

Watershed Boundary -- The divide separating one drainage basin from another.

BIBLIOGRAPHY

Flood Hazard Evaluation Guidelines for Federal Executive Agencies, United States Water Resources Council, May 1972.

Flood Insurance Study Guidelines, U.S. Department of Housing and Urban Development, Federal Insurance Administration, April 1974.

Floodway Determination Computer Program, Technical Release No. 64, U.S. Department of Agriculture, Soil Conservation Service, June 1978.

Gould, F.W., 1975, Texas Plants -- A Checklist and Ecological Summary, Misc., Publ., 585/revised, Texas Agricultural Experiment Station, College Station, Texas.

Hydraulics of Bridge Waterways, U.S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads, Second Edition, September 1973.

National Engineering Handbook, Section 4, Hydrology, U.S. Department of Agriculture, Soil Conservation Service, 1972.

National Engineering Handbook, Section 5, Hydraulics, U.S. Department of Agriculture, Soil Conservation Service, 1956.

Preliminary Investigation of Madera Canyon Watershed, Jeff Davis County and Reeves County, Texas. Unpublished Report, U.S. Department of Agriculture, Soil Conservation Service, Temple, Texas, March 1967.

Rainfall Frequency Atlas of the United States, Technical Paper No. 40, U. S. Weather Bureau, May 1961.

Regulations of Flood Hazard Areas, Volumes 1 and 2, United States Water Resources Council.

Resource Conservation Glossary, 3rd Edition 1982, SCSA, Ankeny, Iowa 50021.

Shaw, S.P. and C.G. Fredine, 1971, Wetlands of the United States, Circular 39, USDI, Fish and Wildlife Service, Washington, D.C.

Soil Survey of Jeff Davis County, Texas, USDA, Soil Conservation Service, May 1977.

Soil Survey of Reeves County, Texas, USDA, Soil Conservation Service, June 1980.

WSP2, A Computer Program for Determining Flood Elevations and Flood Areas for Certain Flow Rates, Technical Release No. 61, U.S. Department of Agriculture, Soil Conservation Service, May 1976.

APPENDIX

APPENDIX

TABLE OF CONTENTS

	Page
TECHNICAL APPENDIX	1
INVESTIGATIONS AND ANALYSES	1
Field Surveys	1
Hydrologic and Hydraulic Methods	1
Flood Hazard Evaluation	3
Estimates of Flood Losses	3
Inventory of Natural Values	3
Public Participation	4
Management Alternatives	4
INDEX TO FLOOD HAZARD AREA PHOTOMAPS AND WATER SURFACE PROFILES	5
PHOTOMAP INDEX	7
FLOOD HAZARD AREA PHOTOMAPS	9
FLOOD PROFILES	69
PLOTTINGS OF TYPICAL STREAM CROSS SECTIONS	99
ELEVATION AND DISCHARGE TABULATIONS	103
ELEVATION REFERENCE MARKS	105

TECHNICAL APPENDIX

This Technical Appendix to the Toyah Creek Flood Plain Management Study Report is a compilation of the FPMS technical findings. It includes the photomap index, flood hazard area photomaps, flood profiles, plottings of typical stream cross sections, elevation and discharge tabulations and a listing of pertinent elevation reference marks. Other technical data developed during this study are on file in the USDA Soil Conservation Service State Office, W.R. Poage Federal Building, 101 South Main Street, Temple, Texas 76501-7682.

INVESTIGATIONS AND ANALYSES

FIELD SURVEYS

Topographic data were obtained from Geological Survey topographic maps and field surveys. Engineering surveys were made of cross sections selected to represent the stream hydraulics and flood plain areas (refer to the sheets of typical valley cross section, Appendix, pages 99 to 101). Elevations appearing in this report are based on mean National Geodetic Vertical Datum of 1929. Temporary elevation reference marks were established by American Geodetic Survey Company in 1984. Table 3 Appendix, pages 105 to 112, shows the listings, descriptions, and location of permanent and temporary elevation reference marks.

HYDROLOGIC AND HYDRAULIC METHODS

The Toyah Creek and Sandia Creek watershed boundaries were determined by use of Geological Survey topographic maps. The top of the watershed

begins approximately 34 miles southwest of Balmorhea in the Davis Mountains, Jeff Davis County. Hydraulic evaluations were based on synthetic frequency methods. Rainfall frequency data were obtained from Weather Bureau Technical Paper No. 40, Rainfall Frequency Atlas of the United States. Values greater than the 100-year frequency event were determined by extrapolation of the rainfall versus frequency graph. Peak discharge values were determined by flood routing various storm frequencies with a 24-hour rainfall duration using SCS Technical Release No. 20, A Computer Program for Project Formulation, Hydrology. The program computes surface runoff resulting from any synthetic or natural rainstorm. The program will route the flow through stream channels and reservoirs. Results include, but are not limited to, a combination of the routed hydrograph with those from other tributaries and a printout of the peak discharges, their time of occurence, and the water surface elevations for each computed discharge at any desired cross section or structure.

From the representative stream and road cross sections, water surface profiles were developed by the Modified Slope Area Method. The effects of bridges and culverts on the stream hydraulics were determined by use of the Bureau of Public Roads (BPR) Method. Computations were made using SCS's "WSP2, A Computer Program for Determining Flood Elevations and Flood Areas for Certain Flow Rates."

Using the output data from this program, rating curves were plotted for each cross section. These curves show the relationship between stage or

elevation and discharge. Water surface profiles were developed from these rating curves and the computer results of TR-20 routings.

FLOOD HAZARD EVALUATION

The 500-year and 100-year frequency flood hazard areas are outlined on aerial photographs obtained from the January 1967 Agricultural Conservation and Stabilization Service flight. The flood hazard area boundaries were developed by plotting the computed water surface elevations on the surveyed cross sections and transposing this information to the aerial photographs. The flood hazard areas between the surveyed cross sections were developed through interpretation of Geological Survey topographic maps and the aerial photographs in conjunction with the surveyed cross sections. Actual flood limits may vary slightly on the ground from the outlined area on the photomaps due to map scale and reproduction limitations. For this reason, the water surface elevations from the flood profiles should be used for determining site specific potential flood depths.

ESTIMATES OF FLOOD LOSSES

The number and type of buildings located within the delineated flood hazard areas were determined by Soil Conservation Service personnel through on-the-ground reconnaissance and interviews with local people.

INVENTORY OF NATURAL VALUES

The natural values of the study area flood plain were determined by the Soil Conservation Service, Basin and Area Planning staff biologist

through on-the-ground reconnaissance, interviews of local people and literature search.

PUBLIC PARTICIPATION

The Toyah Creek Flood Plain Management Study Plan of Work was developed through consultation with the local officials and study endorsers.

MANAGEMENT ALTERNATIVES

Nonstructural management alternatives were considered during the flood plain management study and discussed during meetings with local public officials and other interested members of the public. Those considered to have merit and worthy of further study for possible implementation were put in the report.

INDEX
TO

TOYAH CREEK FLOOD PLAIN MANAGEMENT STUDY

FLOOD HAZARD AREA PHOTOMAPS
AND
WATER SURFACE PROFILES

Cross Section Number	Flood Hazard Area Photomap Page Number	Water Surface Profile Page Number	Cross Section Number	Flood Hazard Area Photomap Page Number	Water Surface Profile Page Number
TOYAH CREEK					
1	4	1	15	21,22,23,24	9
2	4, 5	1, 2	16	23,24,25,26,27	10
3	4, 5, 9	2	17	26,29	11
4	5, 9, 10	2	18	26,29	11
5	5, 10	2, 3	19	26,29	11
6	6, 10, 11	3	20	27,28,29,30	11, 12
7	10, 11	3	21	27,28,29,30	12
8	10, 11	3	22	28,30	13
9	10, 11	3, 4	SANDIA CREEK		
10	10, 11, 12	4	23	1,2,3	14
11	12, 13, 14	4, 5	24	1, 2, 3	14
12	13, 14	5	25	2,5,6	14, 15
13	16, 19	7	26	5,6	15
14	19, 20, 21	8	27	5,6,10	15

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

VICINITY MAP

LEGEND

- COUNTY LINE
- RAILROAD
- DIVIDED HIGHWAY
- STATE HIGHWAY
- FARM TO MARKET ROAD
- WATERSHED BOUNDARY
- STREAM CHANNEL STUDY REACH
- 1 PHOTOMAP COVERAGE

INDEX MAP

FLOOD PLAIN MANAGEMENT STUDY

STUDY AREA

TOYAH CREEK

REEVES COUNTY, TEXAS

0 1 2 3 MILES

0 1 2 3 KILOMETERS

SOURCE COUNTY HIGHWAY MAP
POLYCONIC PROJECTION

USDA SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX. 1986

JULY 1986

JOINS SHEET 4

STUDY LIMIT

JOINS SHEET 2

ERM 1.10

24

23

Toyah Creek

N

LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Area of Shallow Flooding

Cross Section Location

Stream Channel

X Elevation Reference Marks

1400 Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET

0 100 200 METERS

APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 1 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 2 OF 30

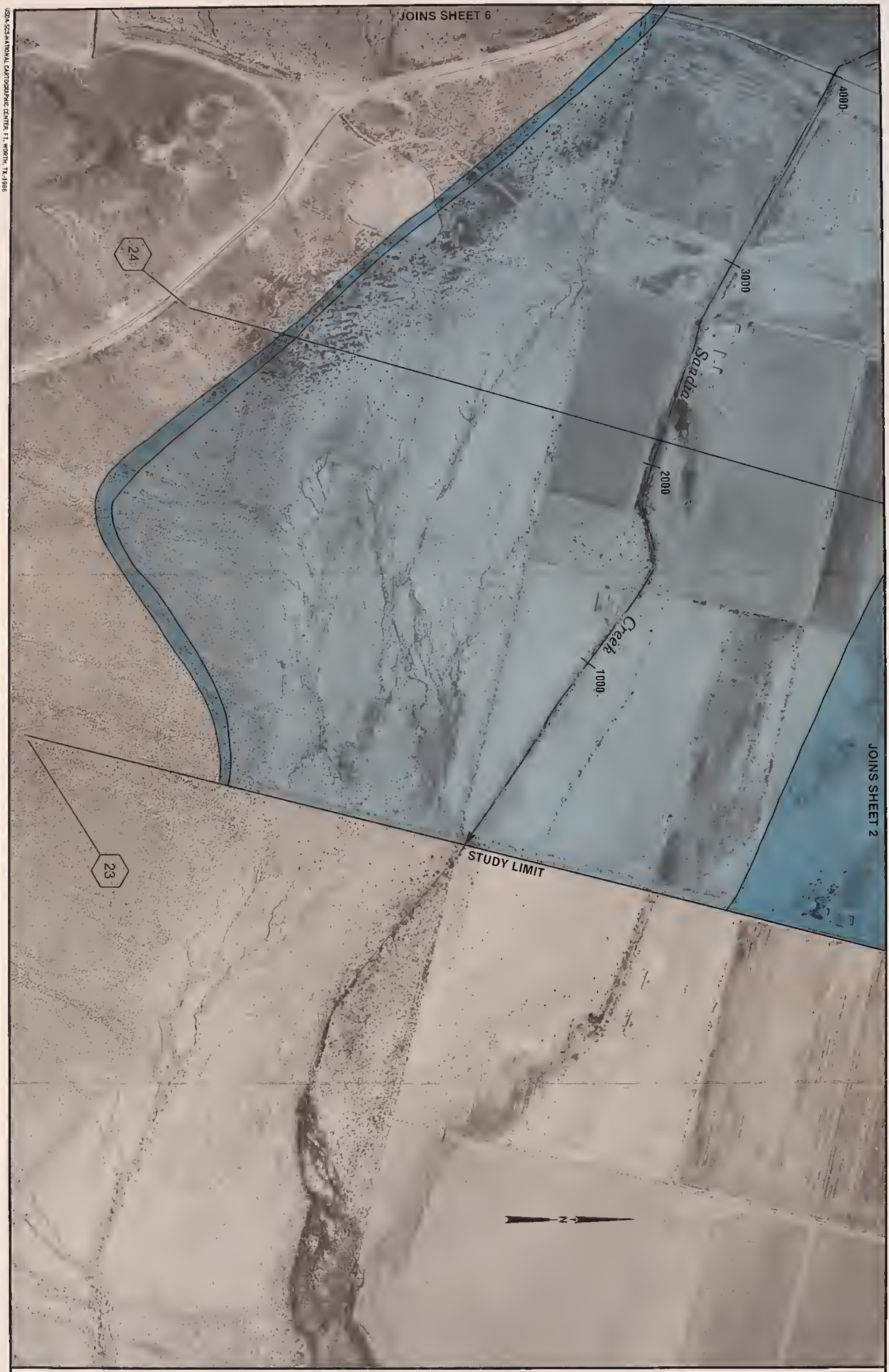
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

JULY 1986 4-R-39824



LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 3 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

JULY 1986 4-R-39824

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 4 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

JULY 1986 4-R-39824

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 5 OF 30

U.S. OEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1985

JULY 1986 4-R-39824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 6 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-339824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 7 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

JOINS SHEET 12

6

8

7

JOINS SHEET 7

BALMORHEA LAKE

2

OCHOA

LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Area of Shallow Flooding

Cross Section Location

Stream Channel

X Elevation Reference Marks

1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET

0 100 200 METERS

APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 8 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

LEGEND

100 Year Flood Hazard Area
500 Year Flood Hazard Area
Area of Shallow Flooding
Cross Section Location
Stream Channel
X Elevation Reference Marks
1400 Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 9 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1985

JULY 1986 4-R-39824

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET; 0 100 200 METERS APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 10 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

JULY 1986 4-R-39824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 11 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

LEGEND

100 Year Flood Hazard Area
500 Year Flood Hazard Area
Area of Shallow Flooding
Cross Section Location
Stream Channel
Elevation Reference Marks
1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 12 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 13 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

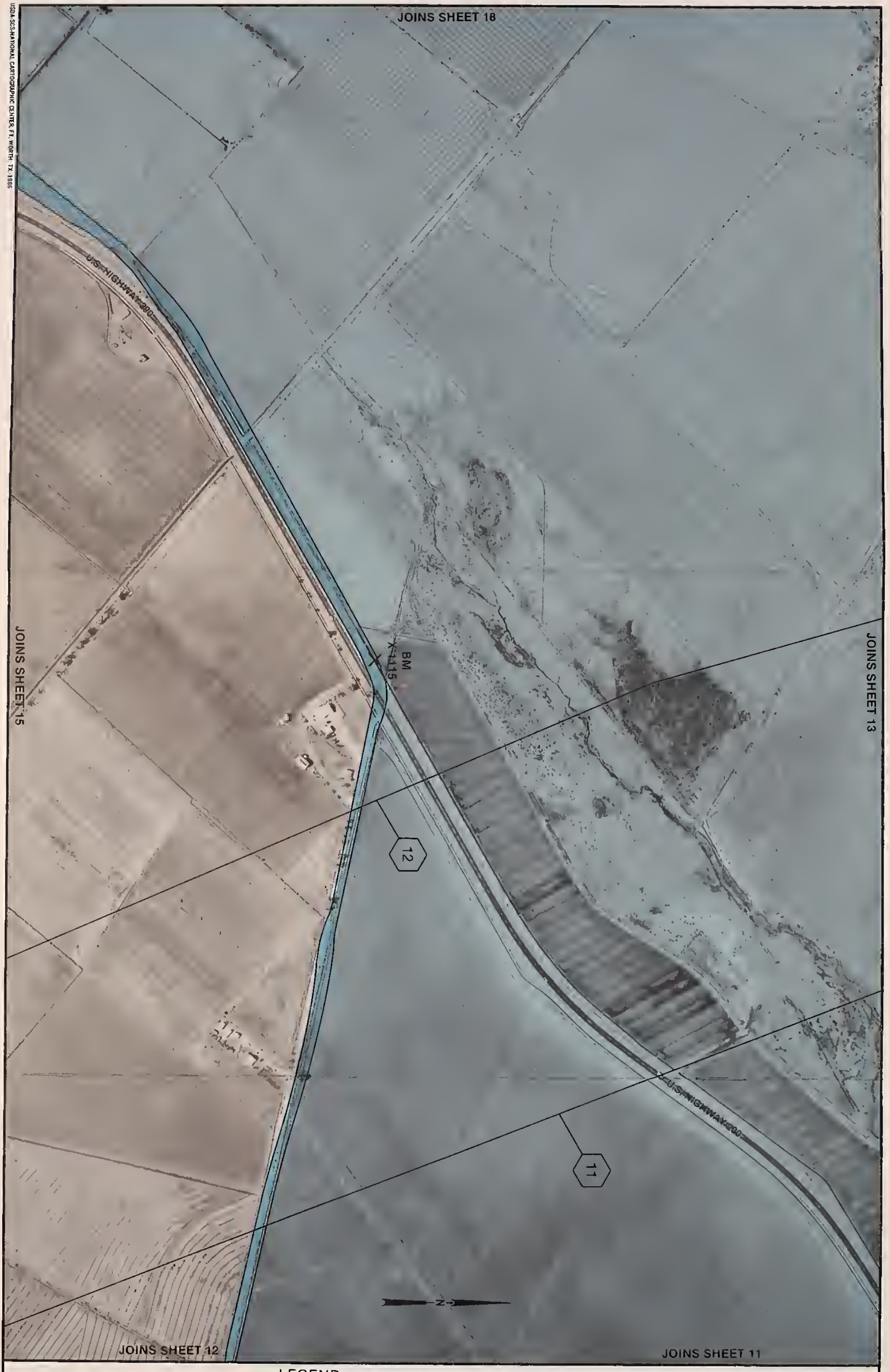
FLOOD HAZARD AREA

TOYAH CREEK

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

JULY 1986 4-R-39824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX. 1986



LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 14 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

JOINS SHEET 19

U.S. HIGHWAY 290

U.S. HIGHWAY 290

13

JOHNS SHEET 16

JOINS SHEET 14

12

ERM 1.4

11

N

JOINS SHEET 12

LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Area of Shallow Flooding

Cross Section Location

Stream Channel

X Elevation Reference Marks

1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET

0 100 200 METERS

APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 15 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 16 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

JULY 1986 4-R-39824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX-1986

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 17 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 18 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

JULY 1986 4-R-39824

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 19 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

LEGEND

100 Year Flood Hazard Area
500 Year Flood Hazard Area
Area of Shallow Flooding
Cross Section Location
Stream Channel
Elevation Reference Marks
1400 — Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

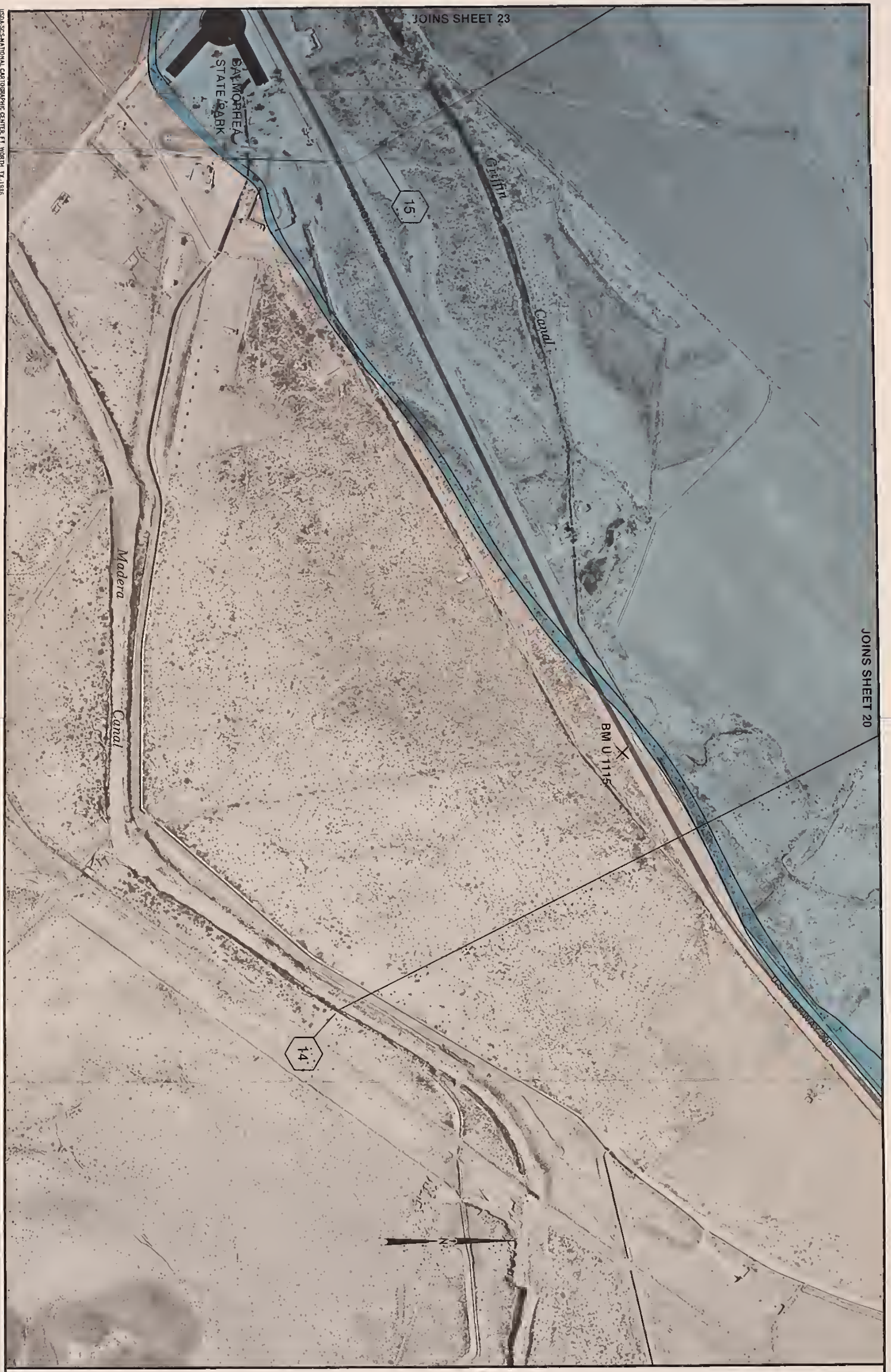
SHEET 20 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824



LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 21 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

JULY 1986 4-R-39824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

JOINS SHEET 25

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

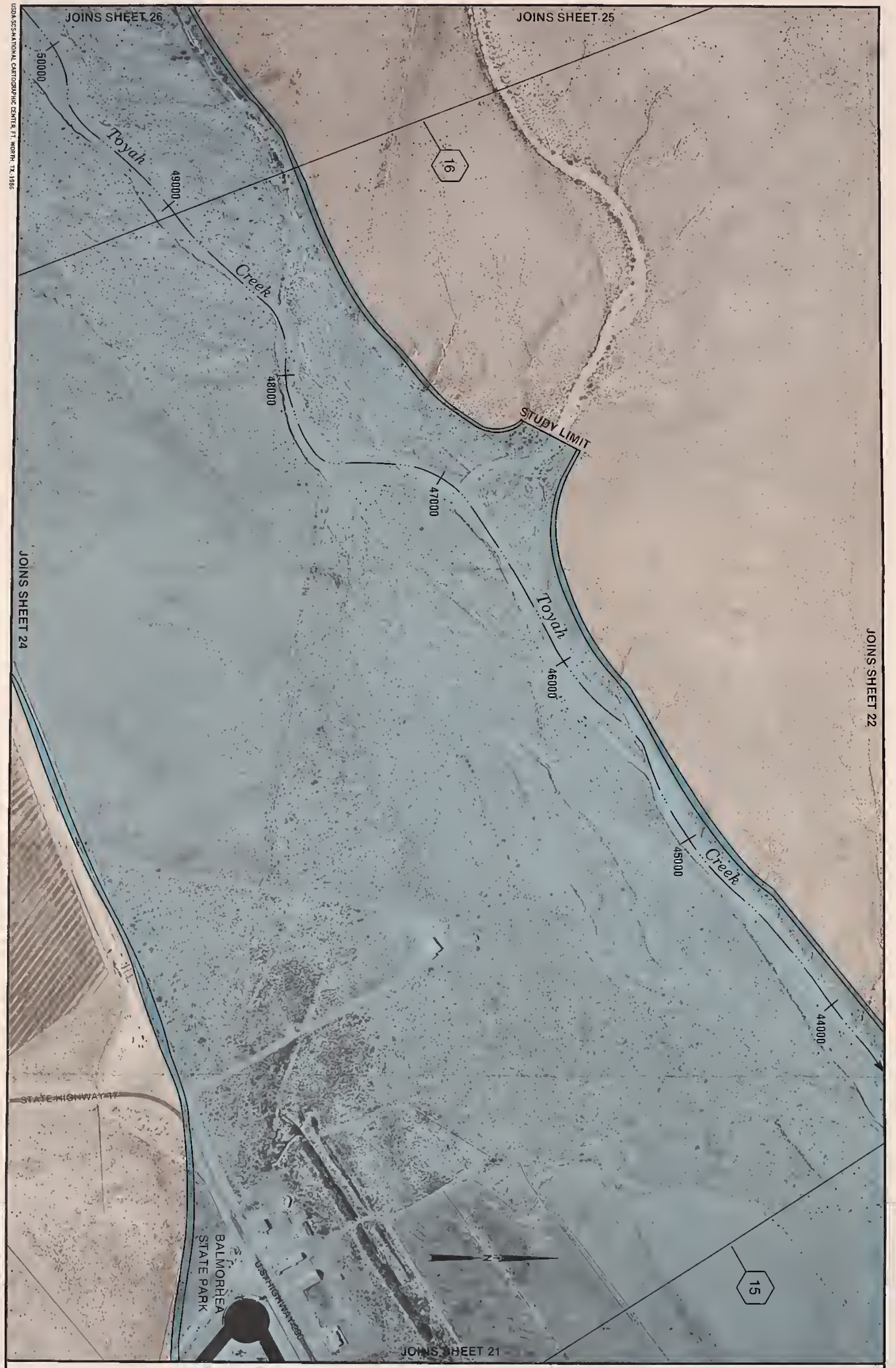
SHEET 22 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824



LEGEND

100 Year Flood Hazard Area
500 Year Flood Hazard Area
Area of Shallow Flooding
Cross Section Location
Stream Channel
Elevation Reference Marks
1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 23 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986
JULY 1986 4 R-39824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

JOINS SHEET 27

JOINS SHEET 26

16

U.S. HIGHWAY 290

Madera Canal

JOINS SHEET 23

STATE HIGHWAY 17

15

JOINS SHEET 21

N

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 24 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R 39824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER FT. WORTH, TX.-1986

JOINS SHEET 26

16

STUDY LIMIT

Toyah Creek

47000

N

JOINS SHEET 23

JOINS SHEET 22

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 25 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

57

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER FT. WORTH, TX-1986

JOINS SHEET 29

N

U.S. HIGHWAY 290

STUDY LIMIT

52000

BM T-1115

JOINS SHEET 27

Toyah Creek

51000

50000

49000

48000

47000

17

18

19

16

U.S. HIGHWAY 290

Toyah Creek

JOINS SHEET 25

JOINS SHEET 24

JOINS SHEET 23

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 26 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-33824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 27 OF 30

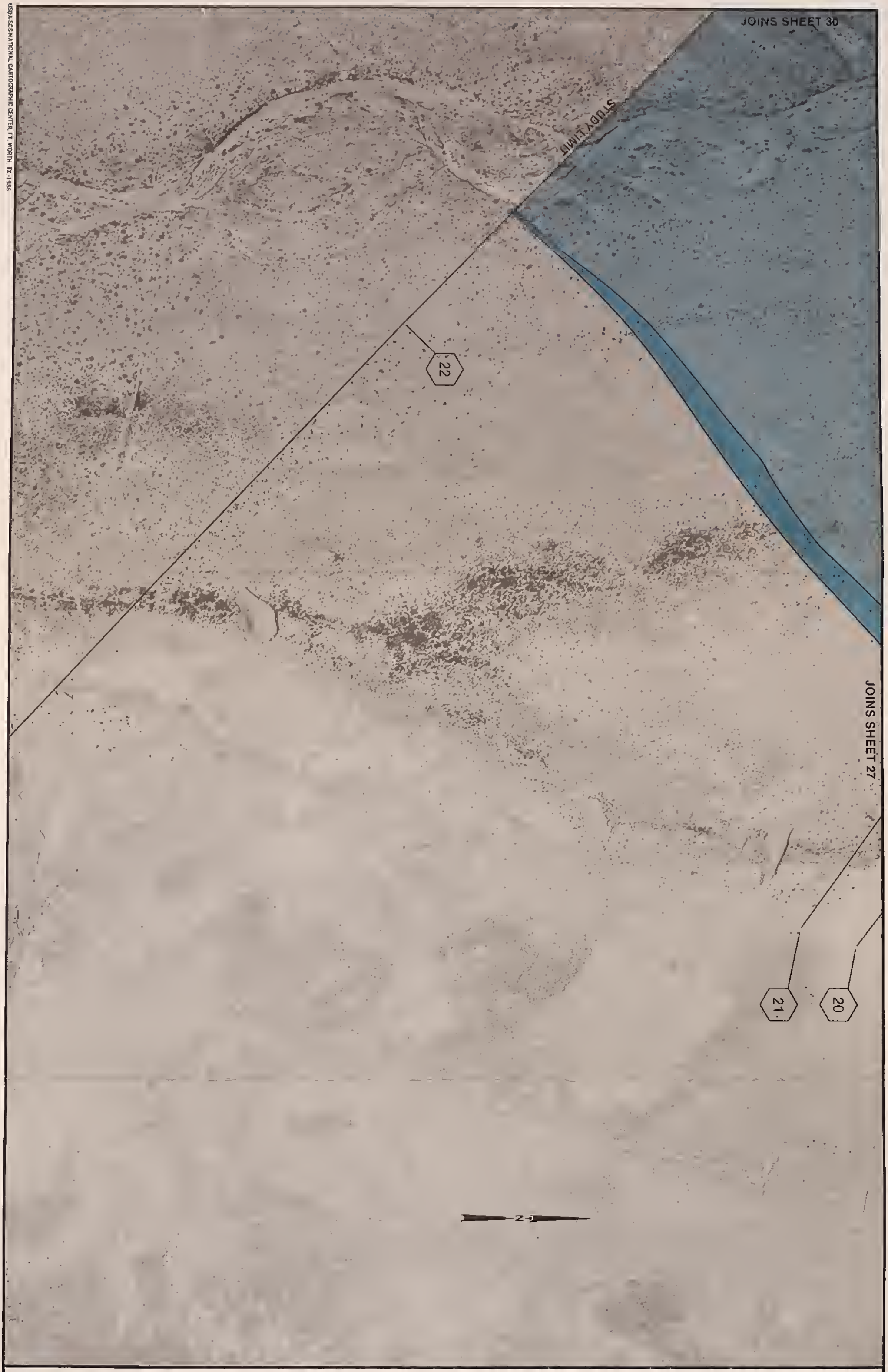
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

USDA-SCS NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1985



LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Area of Shallow Flooding
- Cross Section Location
- Stream Channel
- Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 28 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

LEGEND

100 Year Flood Hazard Area
500 Year Flood Hazard Area
Area of Shallow Flooding
Cross Section Location
Stream Channel
X Elevation Reference Marks
1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 29 OF 30

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

JULY 1986 4-R-39824

65

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

N

JOINS SHEET 29

22

STUDY LIMIT

Toyah Creek

56000

21

20

JOINS SHEET 28

JOINS SHEET 27

LEGEND

100 Year Flood Hazard Area
500 Year Flood Hazard Area
Area of Shallow Flooding
Cross Section Location
Stream Channel
Elevation Reference Marks
1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/4/67

SHEET 30 OF 30

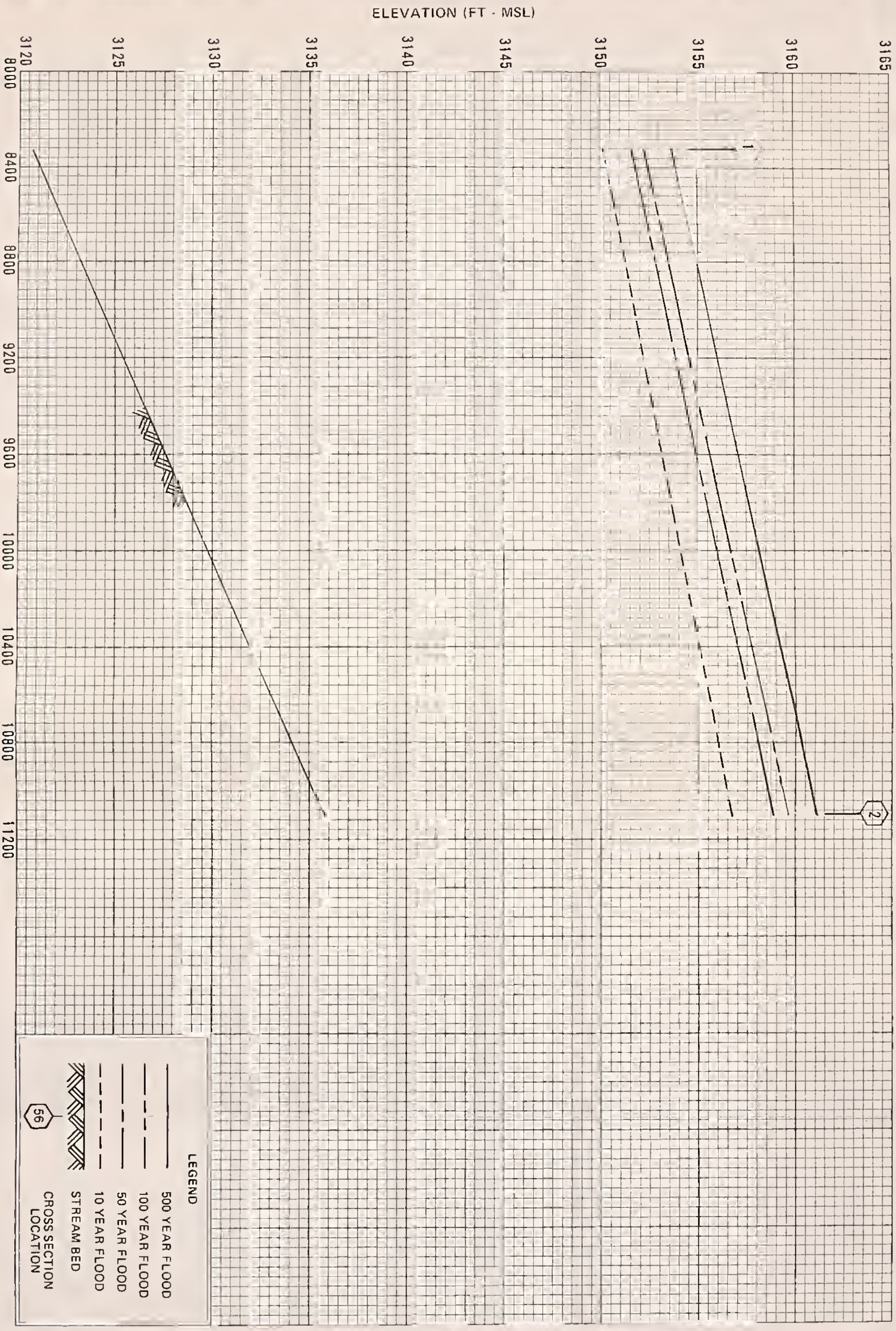
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

FLOOD HAZARD AREA

TOYAH CREEK

67

JULY 1986 4-R-39824

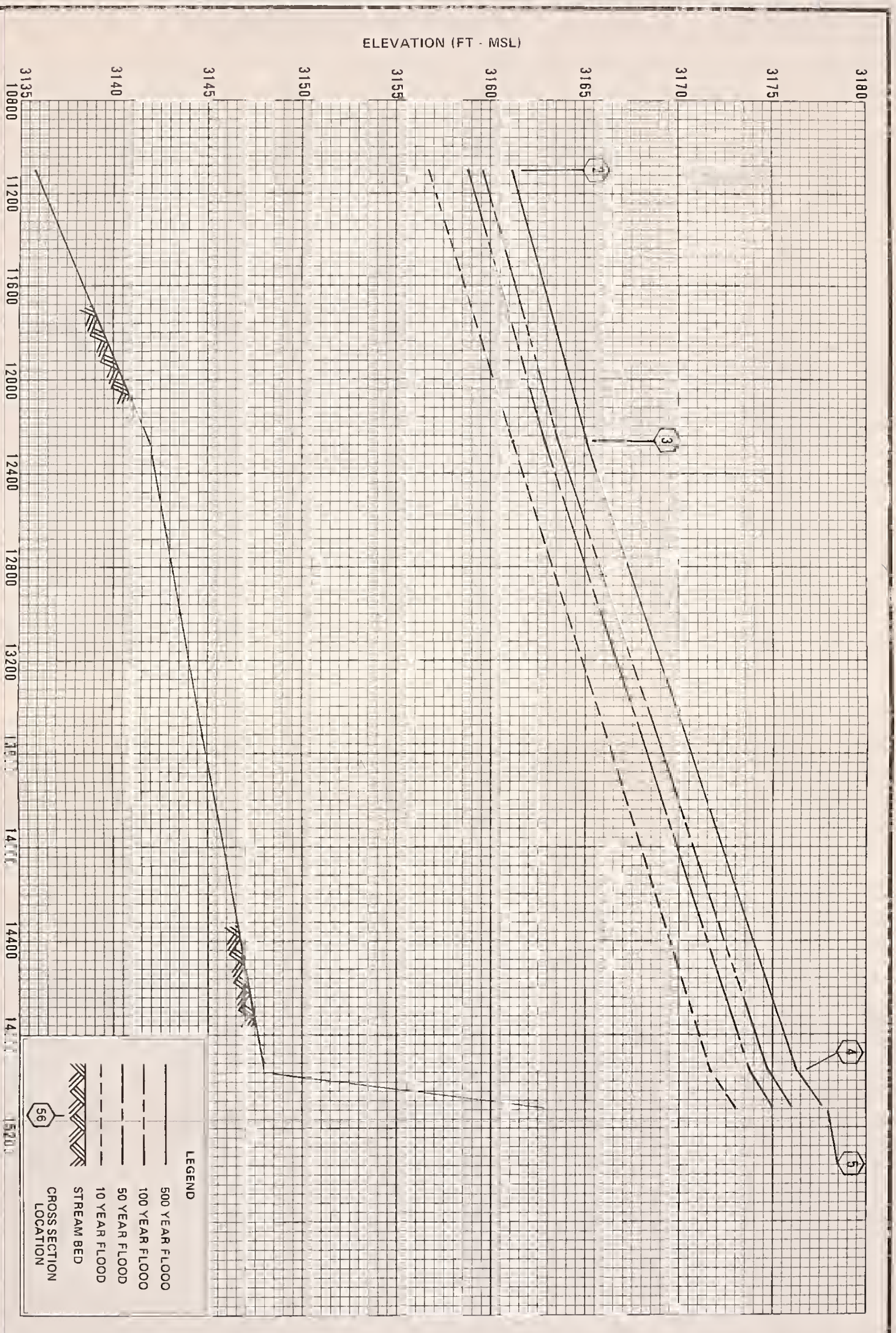


U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

SHEET 1 of 15

WATER SURFACE PROFILES

TOYAH CREEK

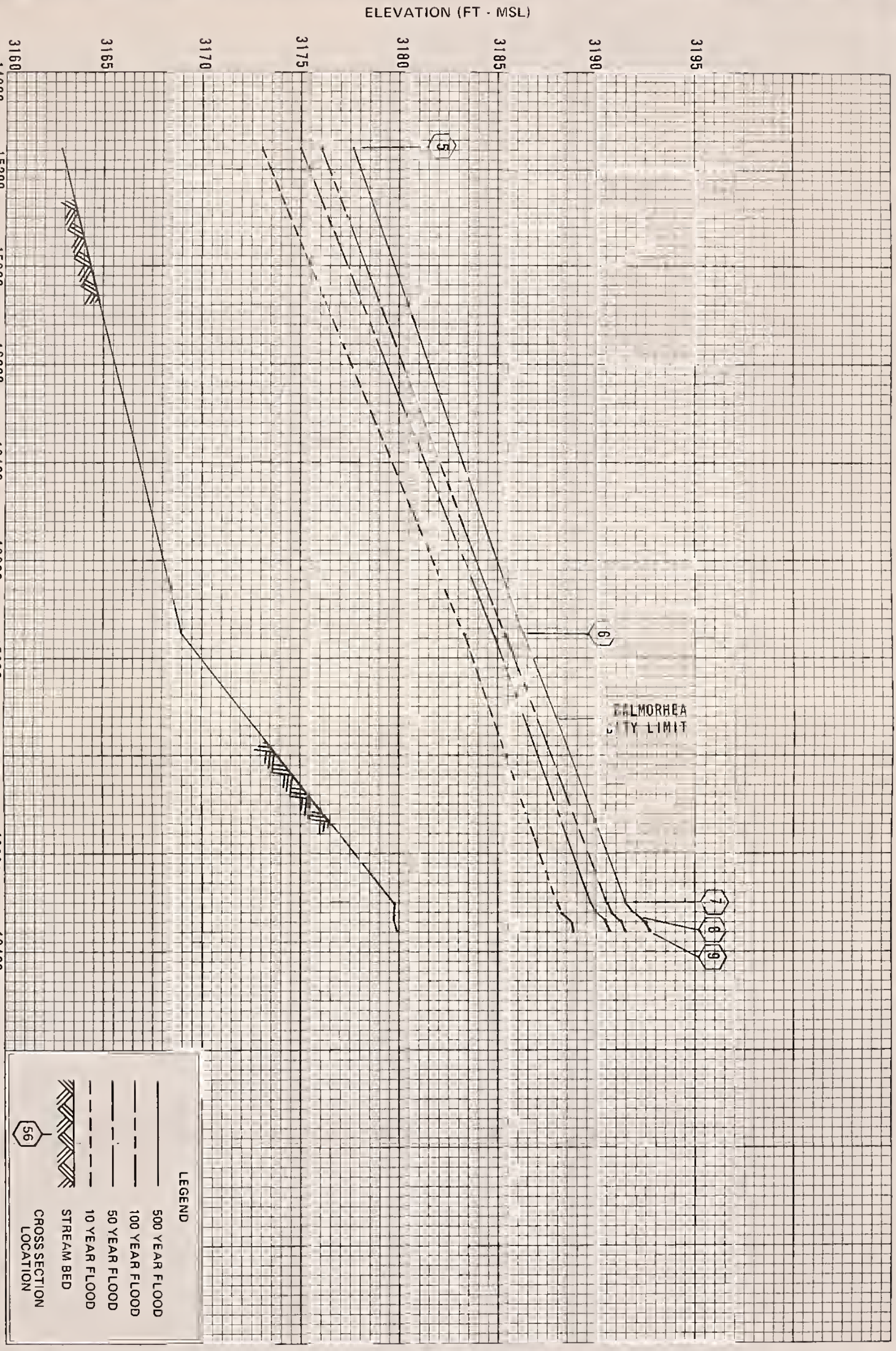


U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

WATER SURFACE PROFILES

TOYAH CREEK

SHEET 2 of 15

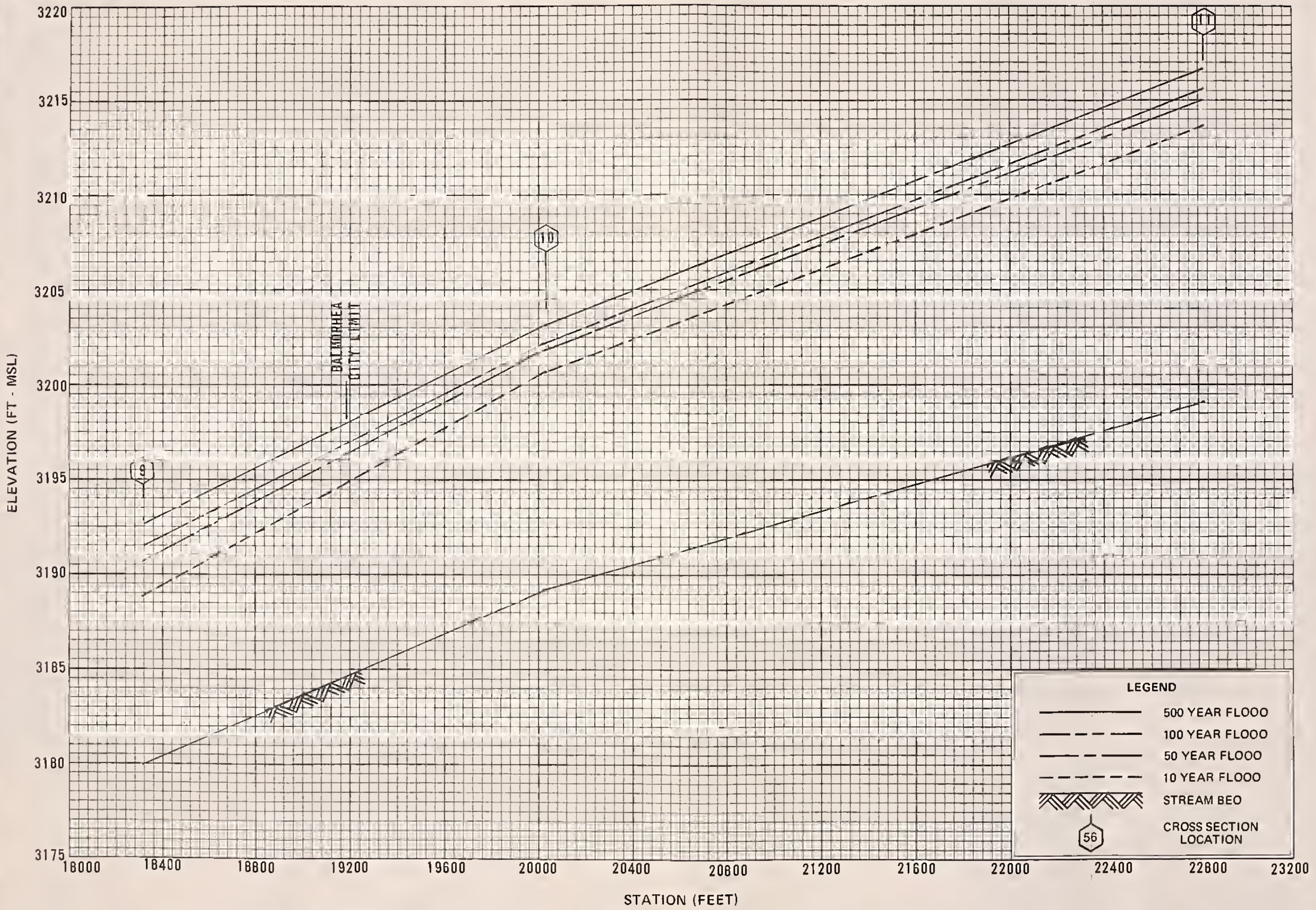


U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

SHEET 3 of 15

WATER SURFACE PROFILES

TOYAH CREEK

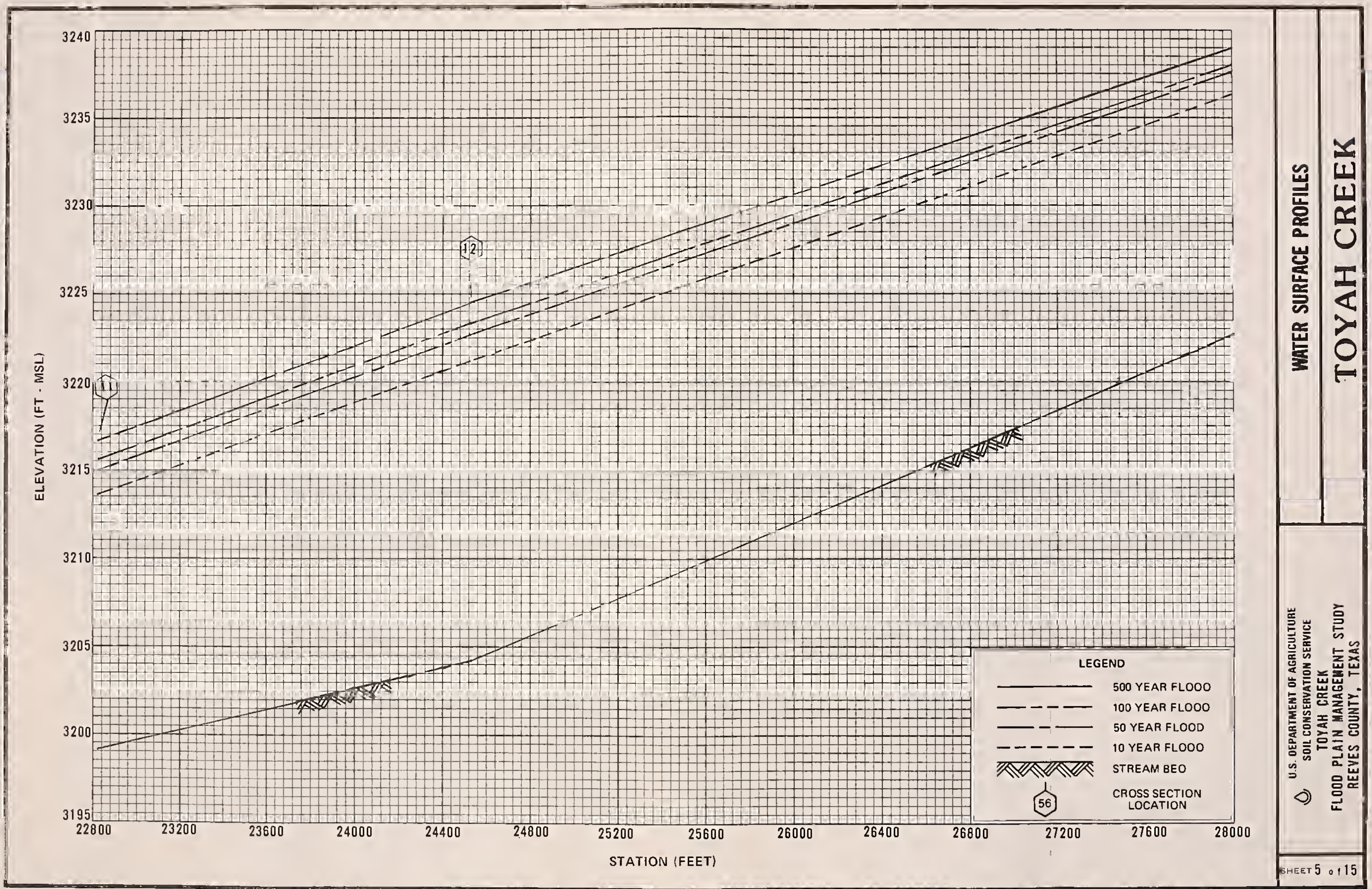


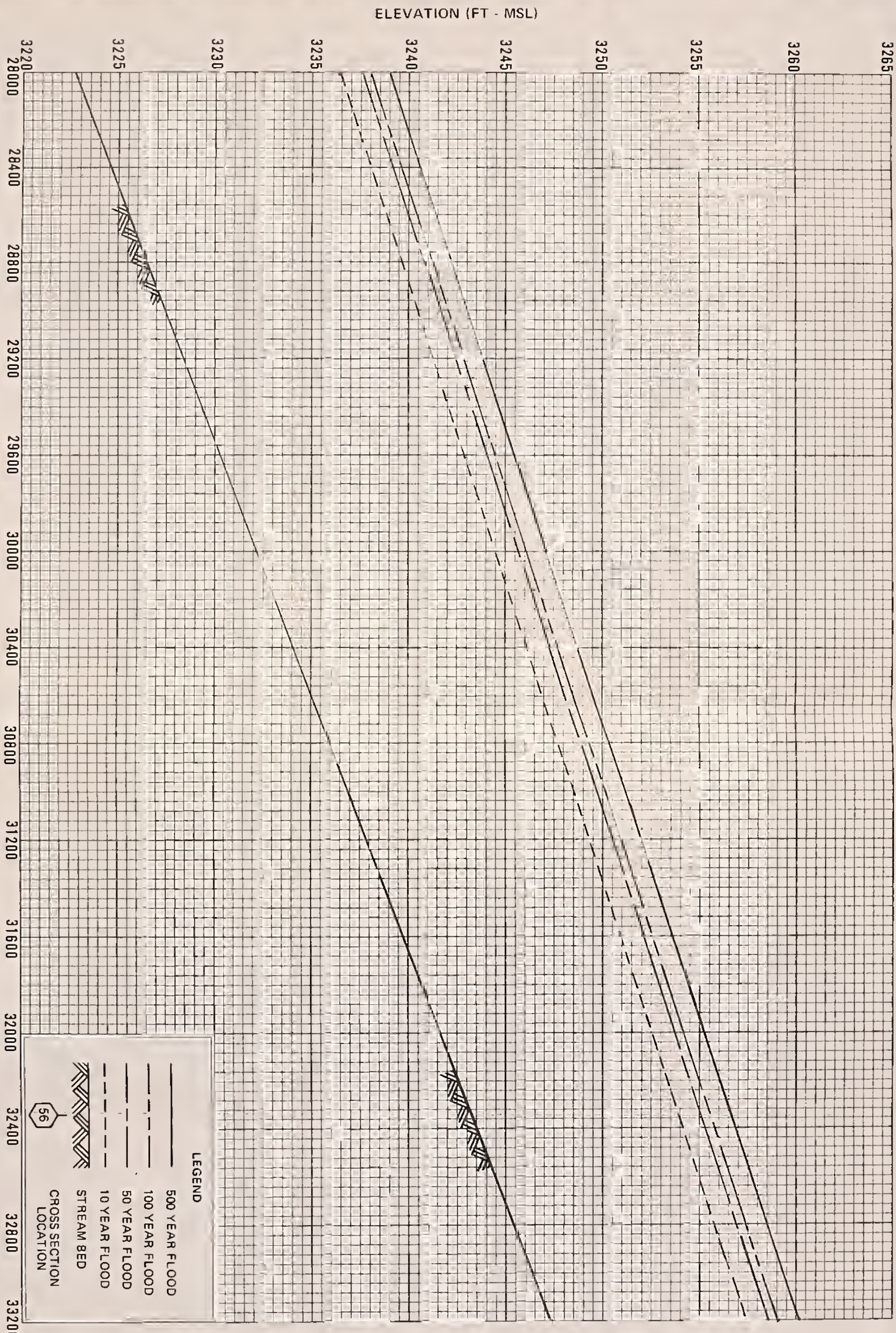
WATER SURFACE PROFILES

TOYAH CREEK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

SHEET 4 of 15


3240
3235
3230
3225
3220
3215
3210
3205
3200
3195
ELEVATION (FT - MSL)
22800
23200
23600
24000
24400
24800
25200
25600
26000
26400
26800
27200
27600
28000
STATION (FEET)
11
12
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
56
CROSS SECTION LOCATION
WATER SURFACE PROFILES
TOYAH CREEK
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS
SHEET 5 of 15

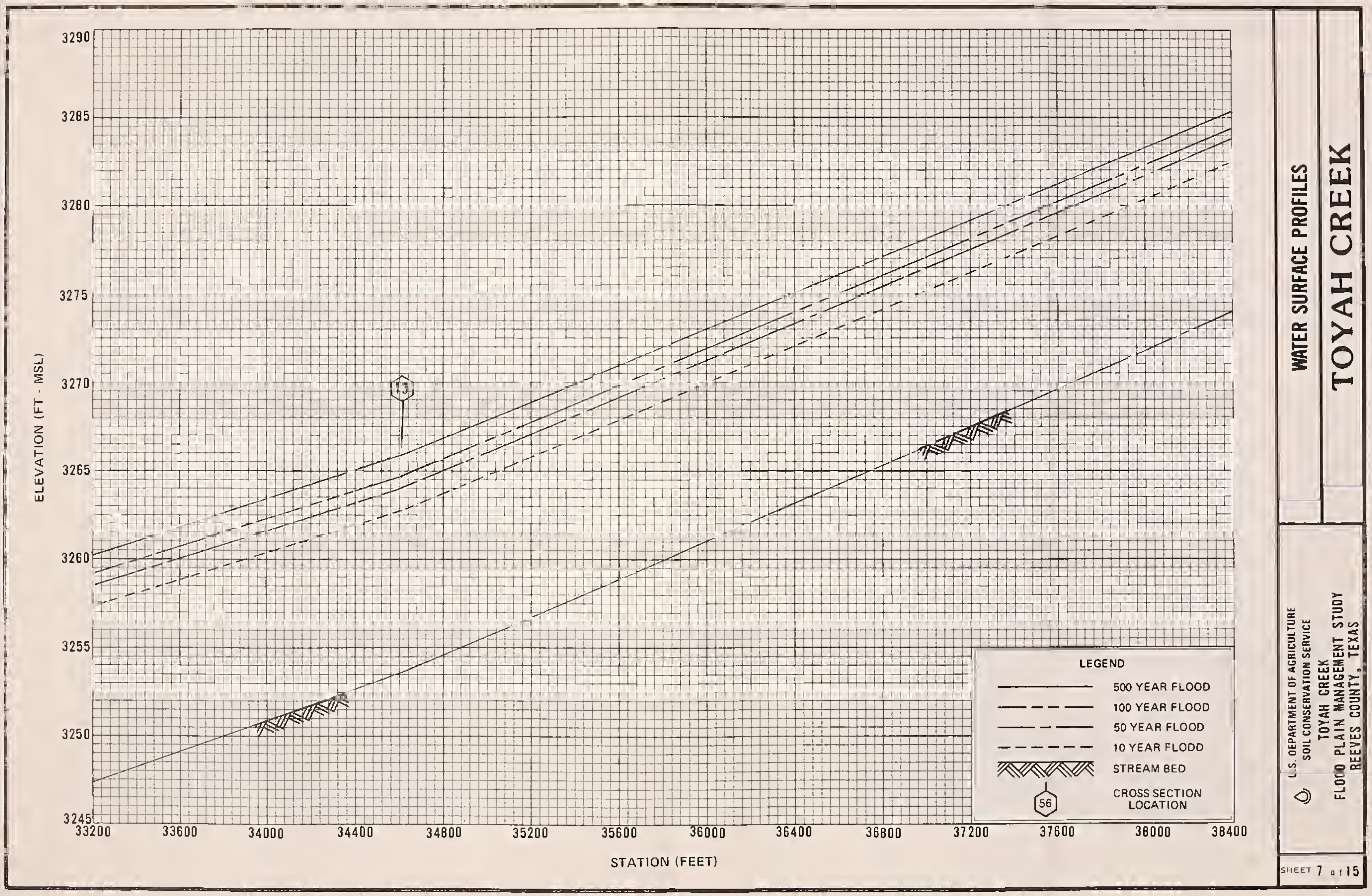


U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

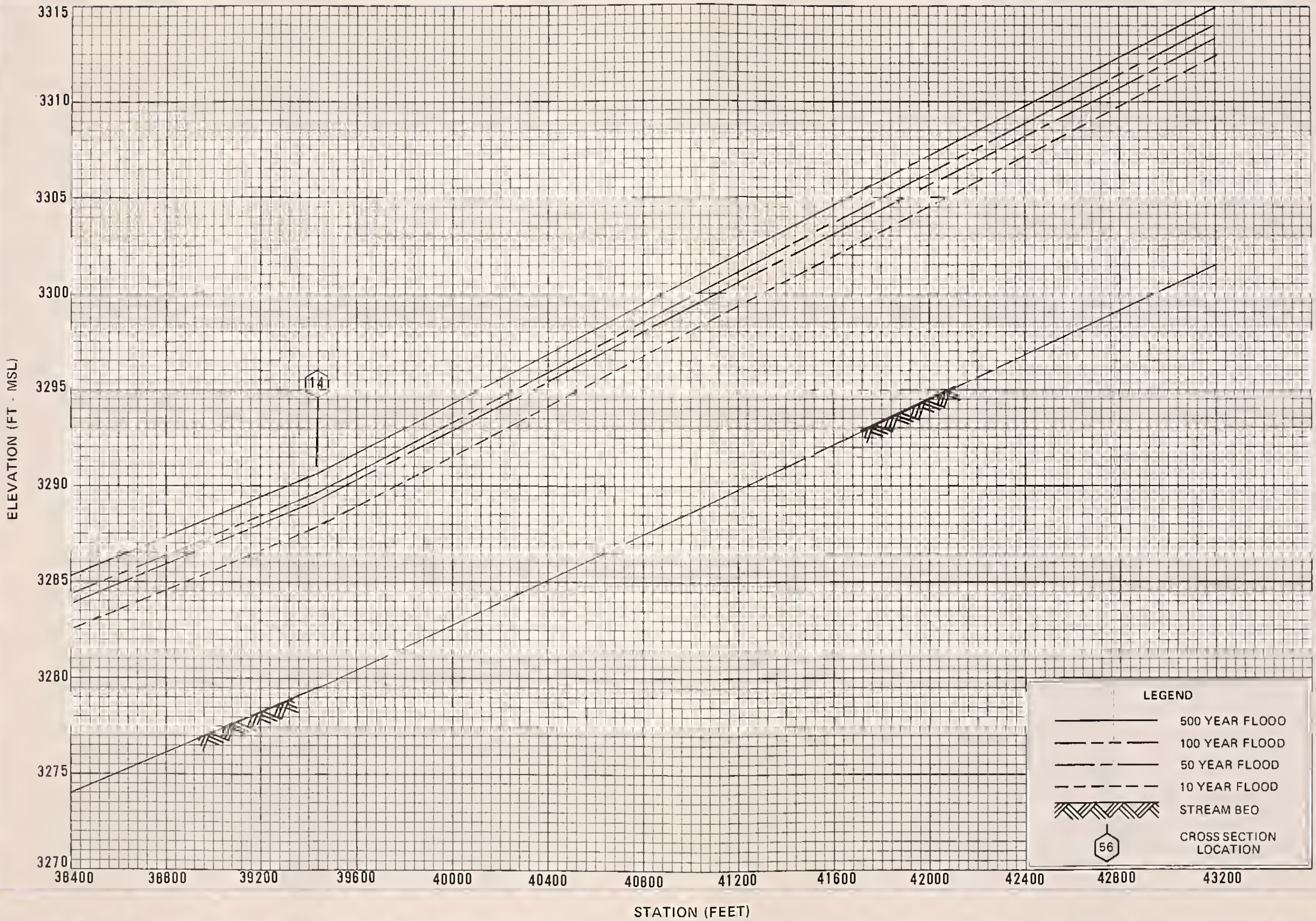
SHEET 6 of 15

WATER SURFACE PROFILES

TOYAH CREEK



ELEVATION (FT - MSL)
3290
3285
3280
3275
3270
3265
3260
3255
3250
3245
33200
33600
34000
34400
34800
35200
35600
36000
36400
36800
37200
37600
38000
38400
STATION (FEET)
13
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
56
CROSS SECTION LOCATION
WATER SURFACE PROFILES
TOYAH CREEK
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS
SHEET 7 of 15

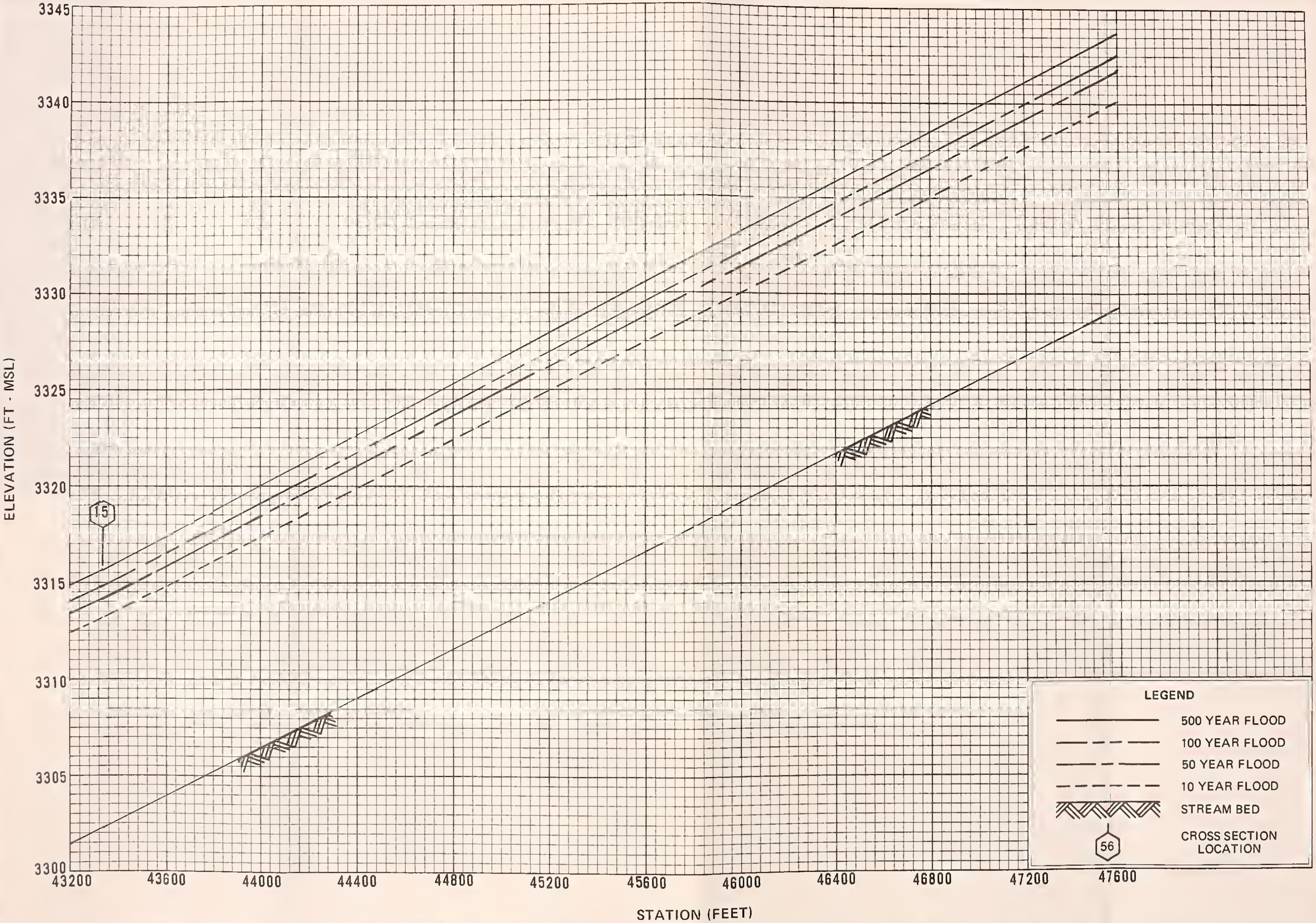


WATER SURFACE PROFILES

TOYAH CREEK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

SHEET 8 of 15

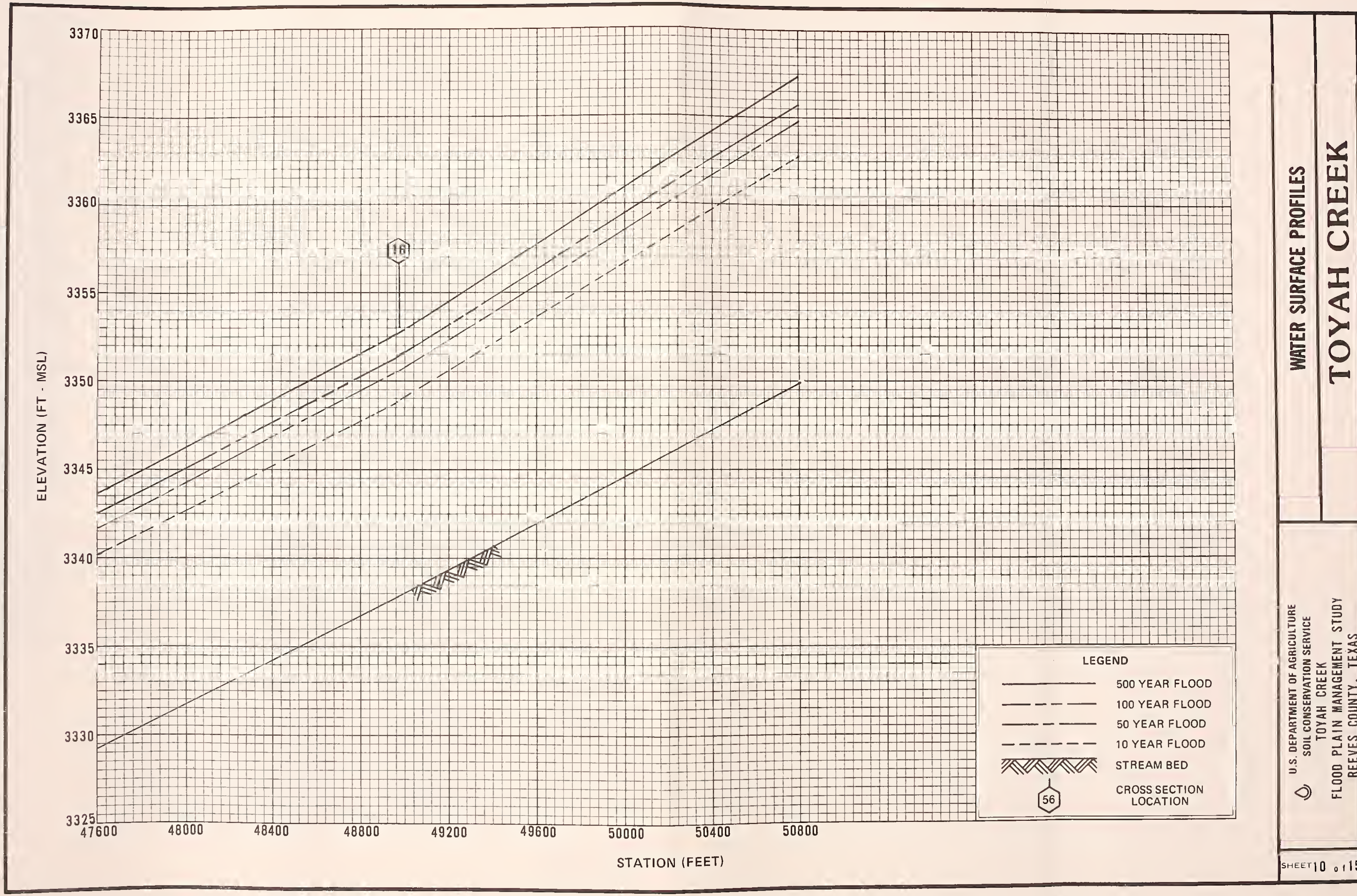


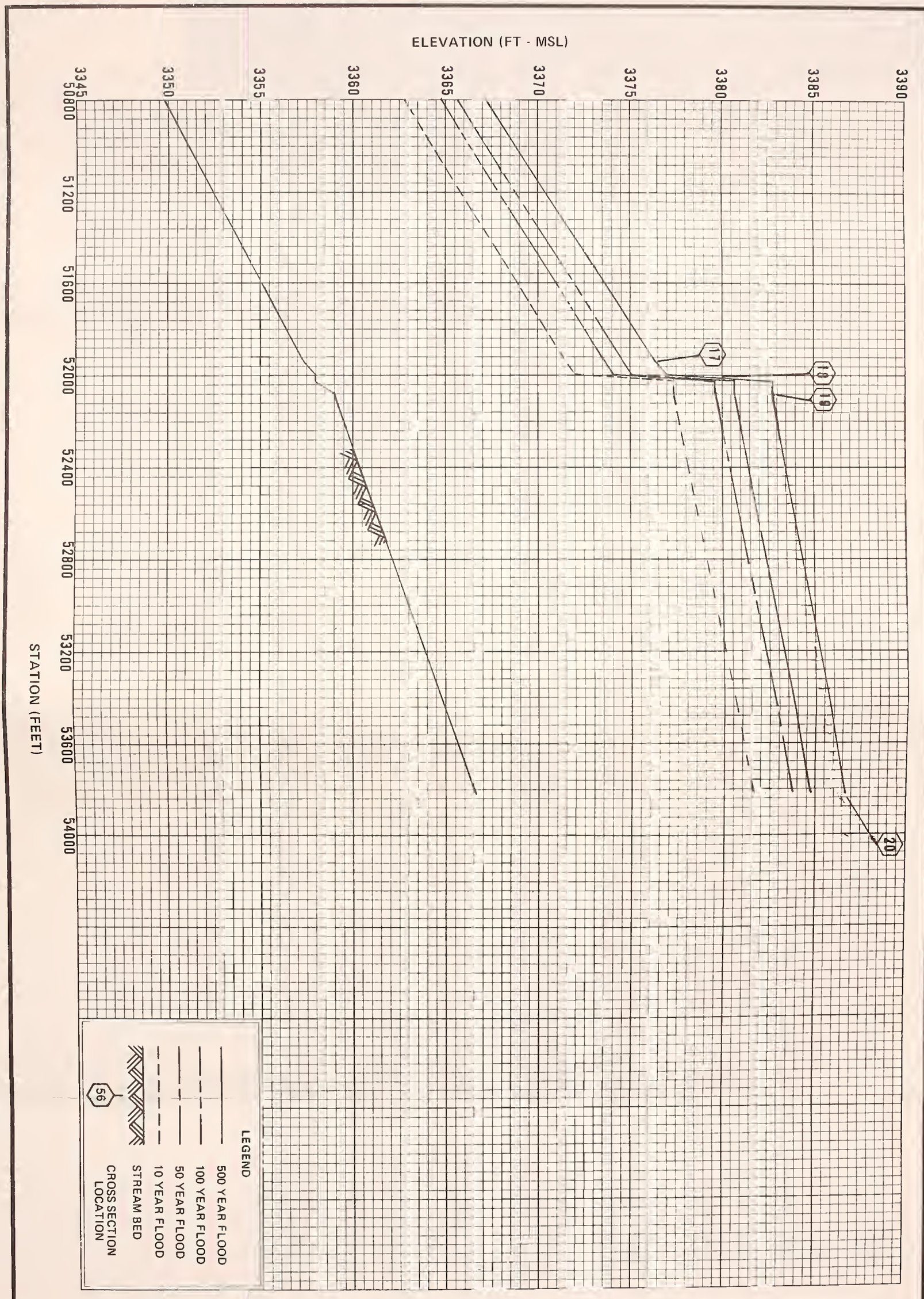
WATER SURFACE PROFILES

TOYAH CREEK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

SHEET 9 of 15


ELEVATION (FT - MSL)
3370
3365
3360
3355
3350
3345
3340
3335
3330
3325
47600
48000
48400
48800
49200
49600
50000
50400
50800
STATION (FEET)
16
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
56
CROSS SECTION LOCATION
WATER SURFACE PROFILES
TOYAH CREEK
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS
SHEET 10 of 15

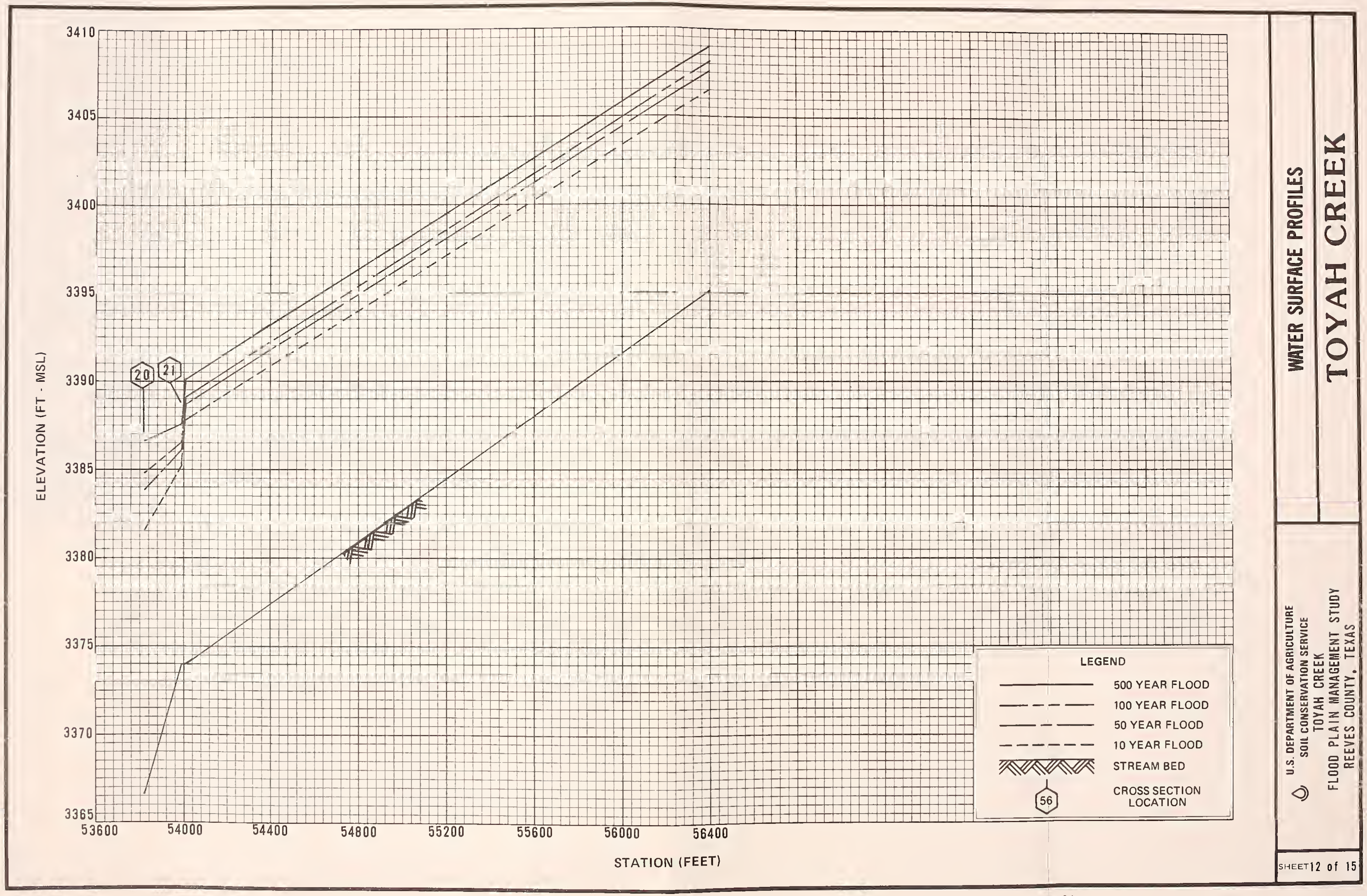


U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

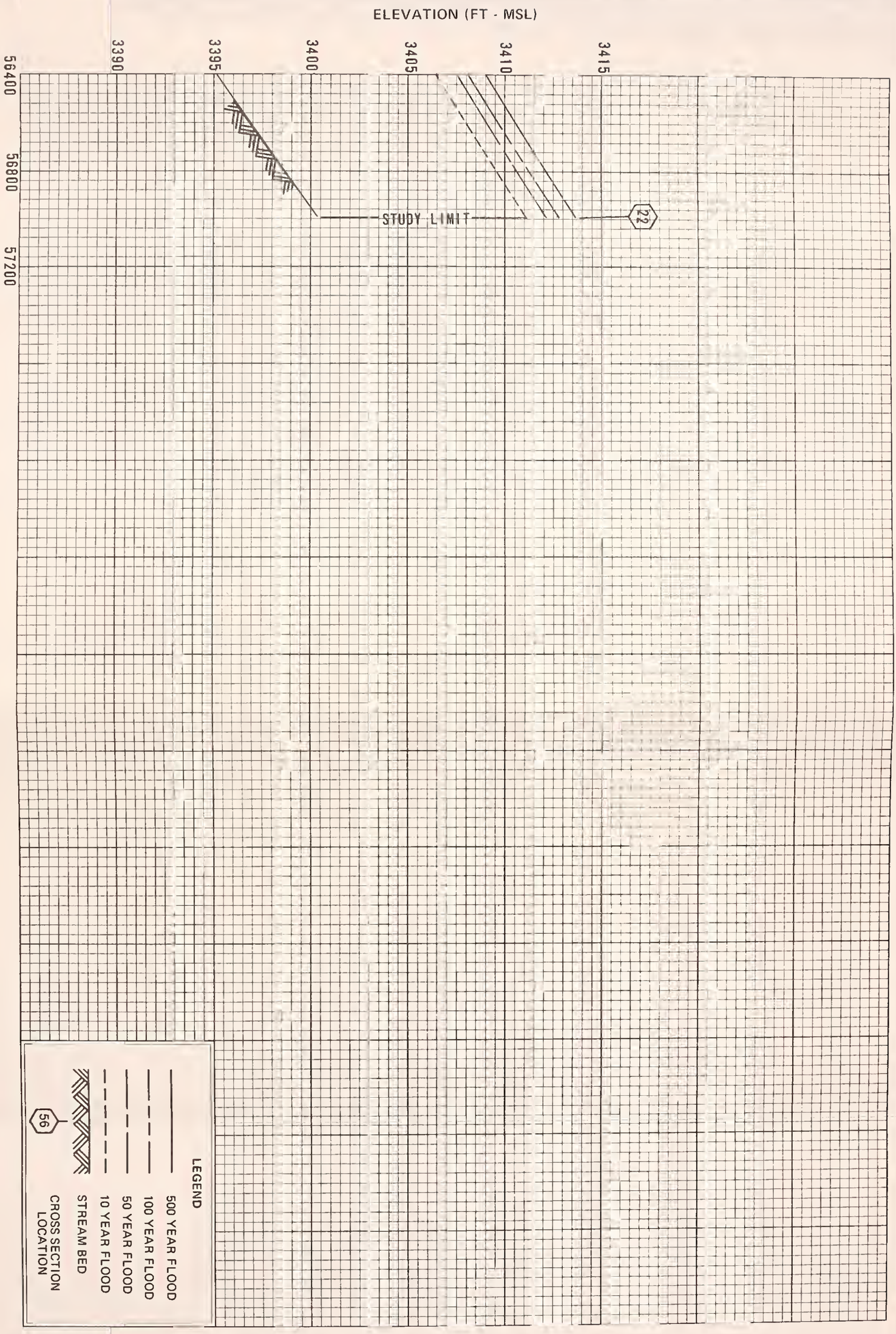
SHEET 11 of 15

WATER SURFACE PROFILES

TOYAH CREEK



WATER SURFACE PROFILES
TOYAH CREEK
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS
SHEET 12 of 15
ELEVATION (FT - MSL)
STATION (FEET)
3410
3405
3400
3395
3390
3385
3380
3375
3370
3365
53600
54000
54400
54800
55200
55600
56000
56400
20
21
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
56
CROSS SECTION LOCATION

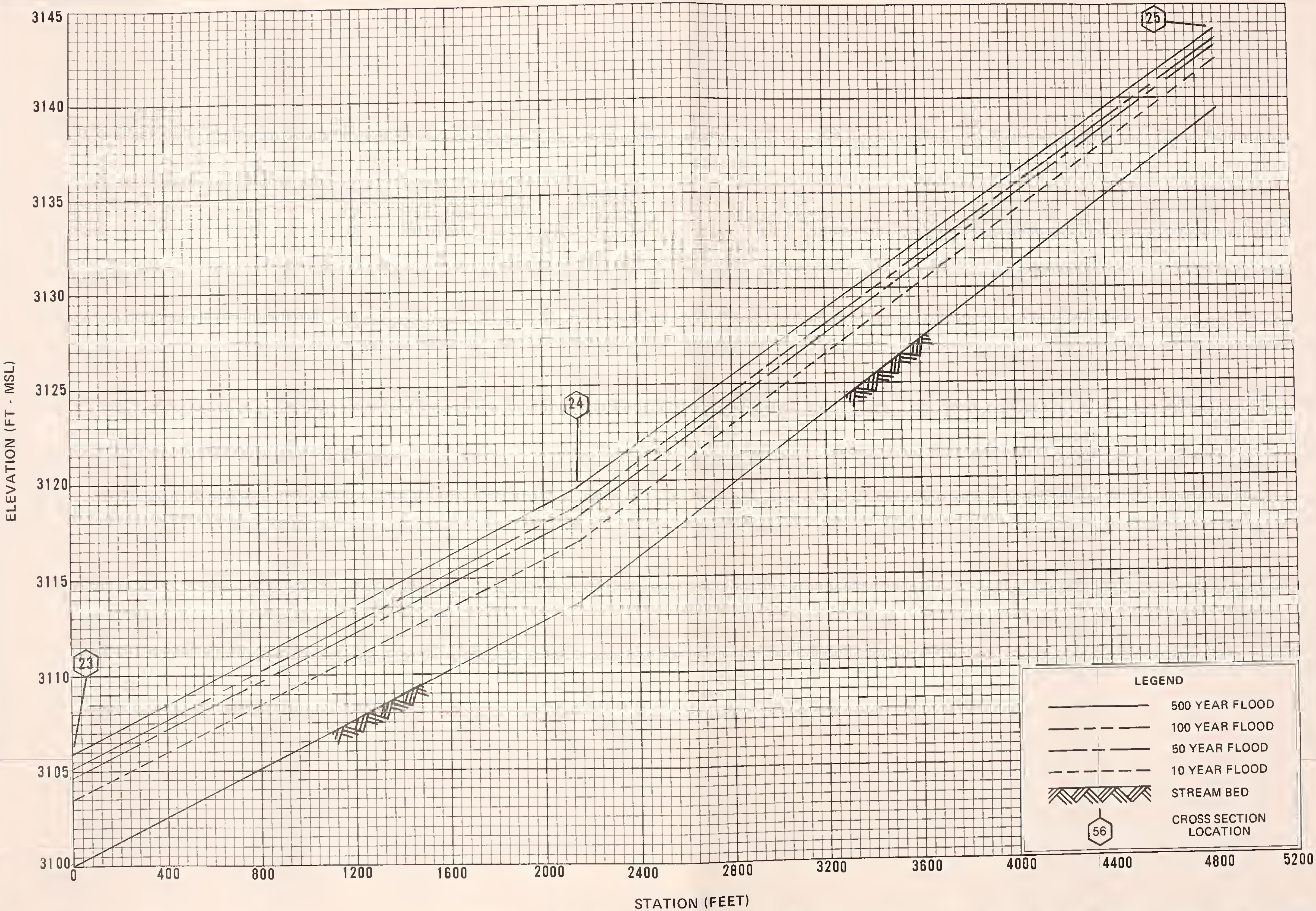


U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

WATER SURFACE PROFILES

TOYAH CREEK

SHEET 13 of 15

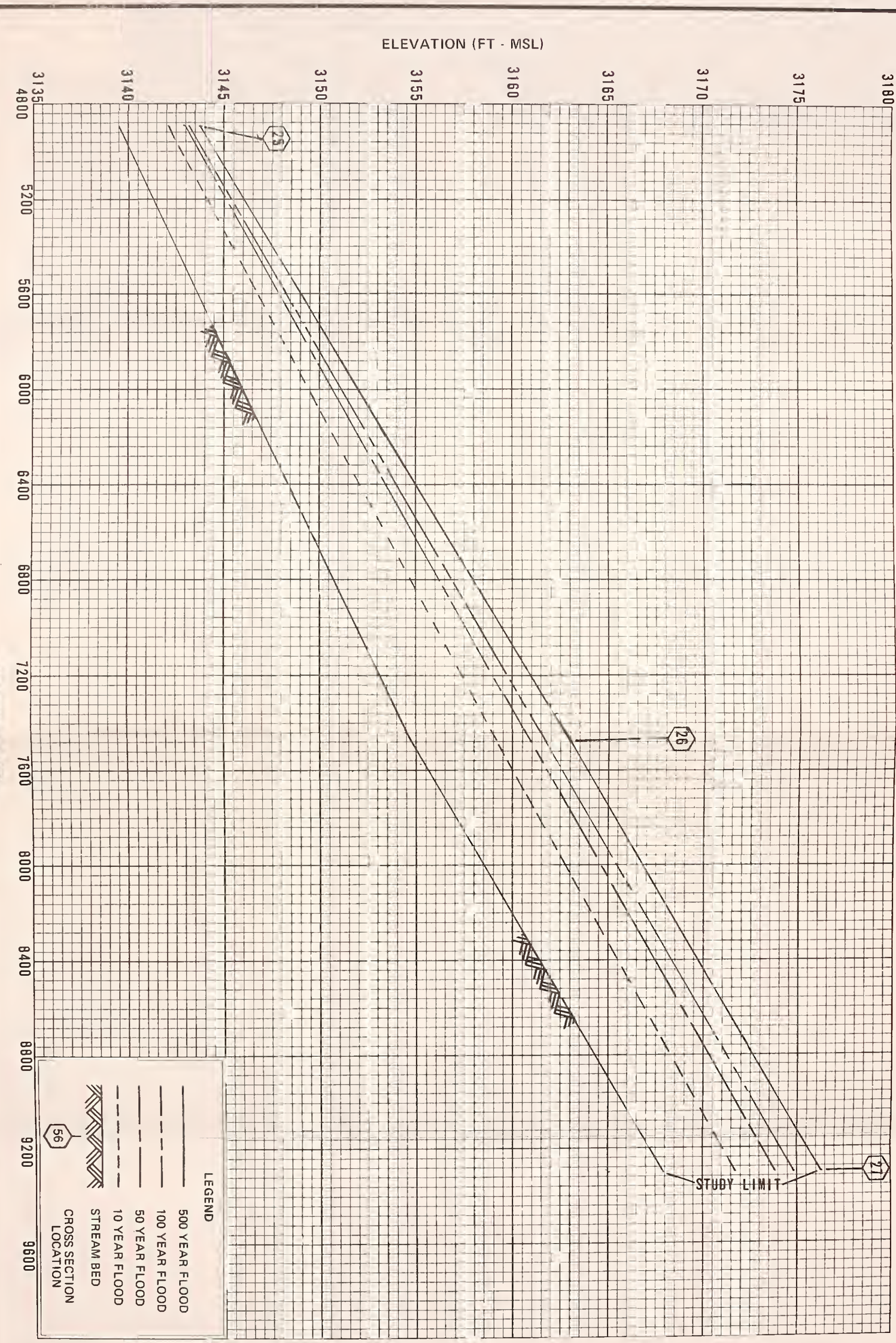


WATER SURFACE PROFILES

SANDIA CREEK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

SHEET 14 of 15

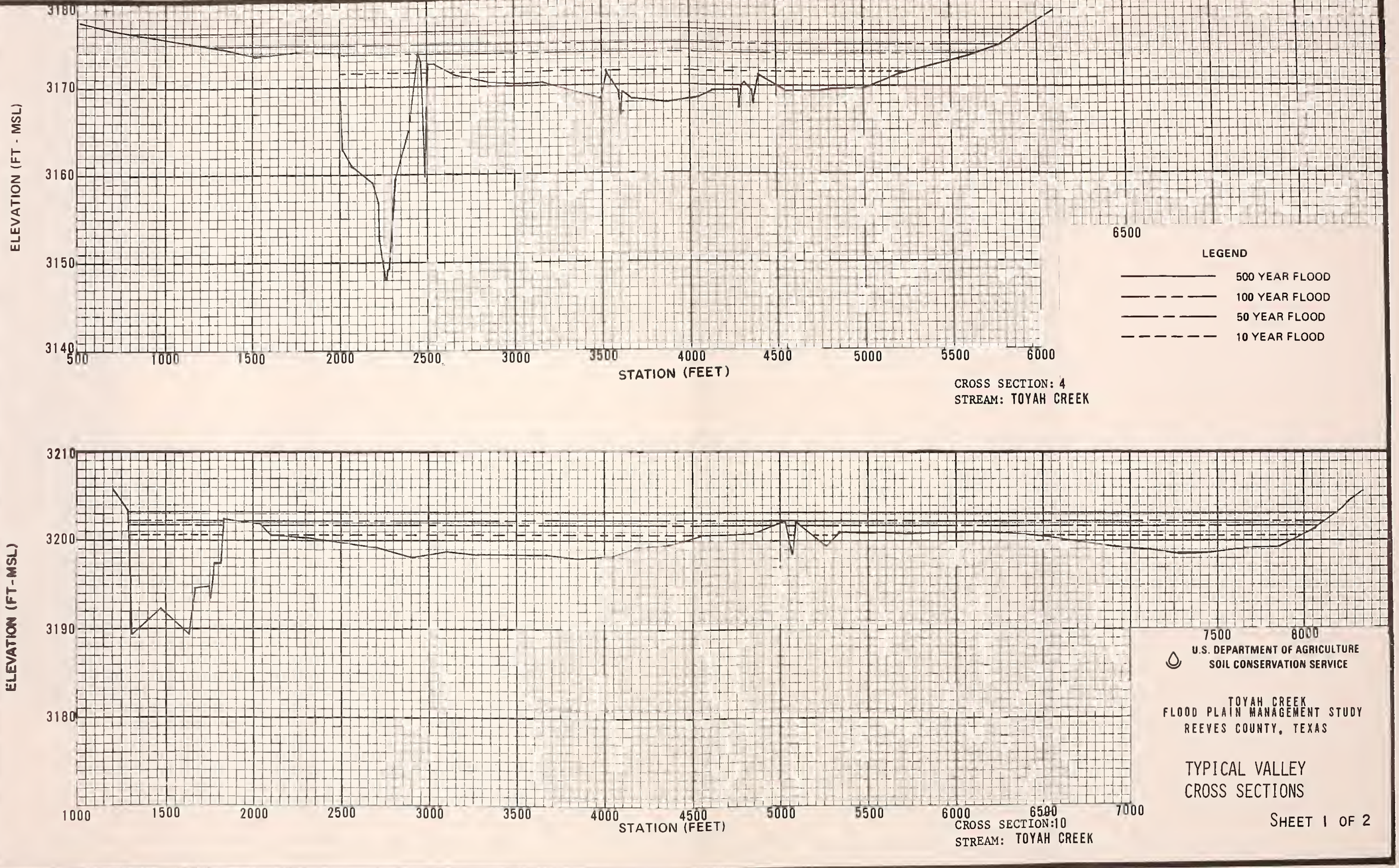


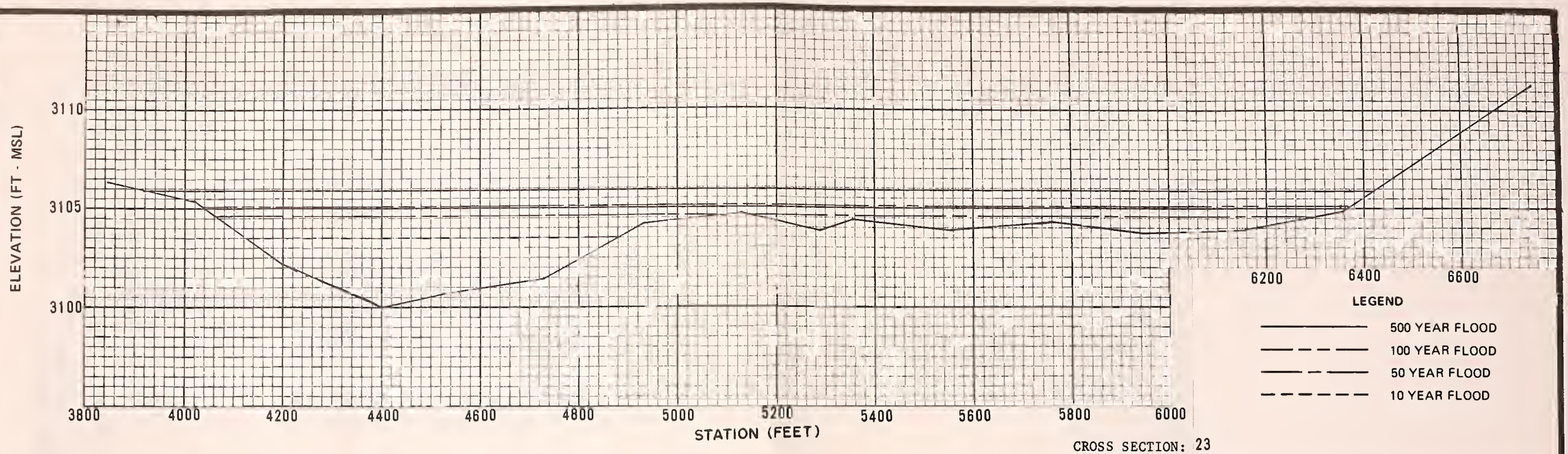
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

WATER SURFACE PROFILES

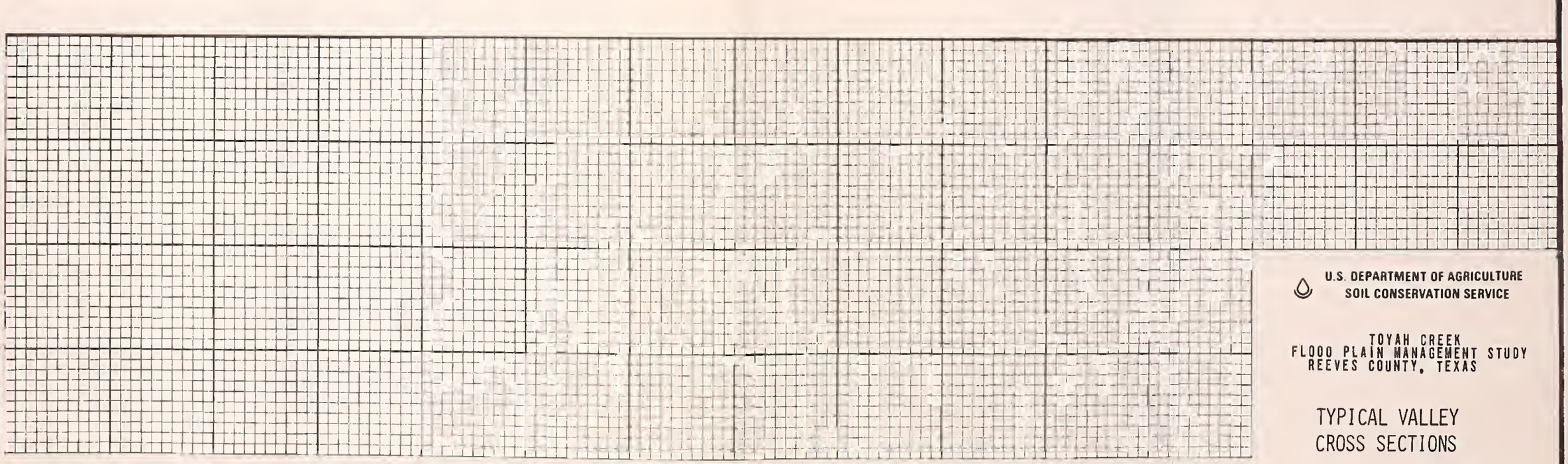
SANDIA CREEK

SHEET 15 of 15


ELEVATION (FT - MSL)
3180
3170
3160
3150
3140
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
STATION (FEET)
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
CROSS SECTION: 4
STREAM: TOYAH CREEK
ELEVATION (FT-MSL)
3210
3200
3190
3180
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
STATION (FEET)
CROSS SECTION:10
STREAM: TOYAH CREEK
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS
TYPICAL VALLEY
CROSS SECTIONS
SHEET 1 OF 2



CROSS SECTION: 23
STREAM: SANDIA CREEK



CROSS SECTION:
STREAM:

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TOYAH CREEK
FLOOD PLAIN MANAGEMENT STUDY
REEVES COUNTY, TEXAS

TYPICAL VALLEY
CROSS SECTIONS

SHEET 2 OF 2

TABLE 2
TOYAH CREEK FLOOD PLAIN MANAGEMENT STUDY
ELEVATION AND DISCHARGE TABULATIONS

PRESENT CONDITIONS

Cross Section Number	10-YEAR FREQUENCY Discharge cfs	10-YEAR FREQUENCY Elevation M.S.L. Feet	10-YEAR FREQUENCY Flood Plain Width Feet	50-YEAR FREQUENCY Discharge cfs	50-YEAR FREQUENCY Elevation M.S.L. Feet	50-YEAR FREQUENCY Flood Plain Width Feet	100-YEAR FREQUENCY Discharge cfs	100-YEAR FREQUENCY Elevation M.S.L. Feet	100-YEAR FREQUENCY Flood Plain Width Feet	500-YEAR FREQUENCY Discharge cfs	500-YEAR FREQUENCY Elevation M.S.L. Feet	500-YEAR FREQUENCY Flood Plain Width Feet
TOYAH CREEK												
1	40241	3150.1	3720	60754	3151.6	3945	73466	3152.3	4050	100091	3153.7	4260
2	40479	3156.7	3331	61060	3158.8	3556	73804	3159.6	3567	100467	3161.2	3590
3	40747	3161.2	3366	61405	3162.9	3640	74185	3163.6	3754	100890	3165.1	4069
4	41008	3171.7	439	61741	3173.8	2060	74555	3174.8	2315	101301	3176.4	2755
5	44827	3173.0	410	68562	3175.0	2018	82727	3176.0	2341	111753	3177.7	2749
6	44843	3183.3	8817	68583	3184.8	10095	82751	3185.4	10369	111787	3186.4	10442
7	44874	3188.0	8857	68625	3189.7	8994	82797	3190.5	9162	111852	3191.6	9318
8	44874	3188.7	8684	68625	3190.5	8690	82797	3191.3	8690	111852	3192.5	9210
9	44874	3188.8	8867	68625	3190.7	9529	82797	3191.5	9560	111852	3192.7	9607
10	44974	3200.6	6708	68761	3201.8	6819	82948	3202.2	6846	112062	3203.2	6913
11	44999	3213.6	3276	68794	3215.0	4321	82985	3215.6	4342	112114	3216.7	4379
12	45029	3221.2	3270	68835	3222.7	4059	83030	3223.4	4214	112176	3224.5	4399
13	45708	3262.7	3171	69542	3264.0	3307	83680	3264.7	3382	112858	3265.9	3777
14	45773	3287.9	5068	69529	3289.2	5229	83640	3289.7	5293	112803	3290.6	5427
15	45893	3313.2	3519	69505	3314.2	3568	83566	3314.8	3598	112702	3315.7	3642
16	45842	3348.8	1616	69375	3350.5	2047	83397	3351.4	2094	112417	3352.7	2110
17	45247	3371.5	903	67880	3373.6	993	81468	3374.6	1036	109170	3376.4	1098
18	45247	3377.4	970	67880	3379.6	1124	81468	3380.7	1201	109170	3382.7	1344
19	45247	3377.4	905	67880	3379.6	1109	81468	3380.7	1181	109170	3382.8	1364
20	45236	3381.6	2250	67850	3383.8	2850	81430	3384.8	3256	109106	3386.7	3579
21	45230	3387.8	3142	67836	3388.7	3560	81411	3389.1	3652	109075	3390.1	3880
22	45186	3411.1	3283	67726	3412.2	3457	81269	3412.8	3537	108836	3413.7	3611

TABLE 2
TOYAH CREEK FLOOD PLAIN MANAGEMENT STUDY
ELEVATION AND DISCHARGE TABULATIONS

PRESENT CONDITIONS

Cross Section Number	10-YEAR FREQUENCY Discharge cfs	10-YEAR FREQUENCY Elevation M.S.L. Feet	10-YEAR FREQUENCY Flood Plain Width Feet	50-YEAR FREQUENCY Discharge cfs	50-YEAR FREQUENCY Elevation M.S.L. Feet	50-YEAR FREQUENCY Flood Plain Width Feet	100-YEAR FREQUENCY Discharge cfs	100-YEAR FREQUENCY Elevation M.S.L. Feet	100-YEAR FREQUENCY Flood Plain Width Feet	500-YEAR FREQUENCY Discharge cfs	500-YEAR FREQUENCY Elevation M.S.L. Feet	500-YEAR FREQUENCY Flood Plain Width Feet
SANDIA CREEK												
23	3847	3103.5	752	6897	3104.6	2251	8274	3105.1	2341	10607	3105.9	3429
24	3841	3116.8	829	6883	3118.1	2844	8256	3118.7	2973	10575	3119.7	3366
25	3836	3142.1	1354	6870	3142.9	1410	8236	3143.2	1430	10542	3143.8	1472
26	3843	3159.2	581	6869	3160.9	632	8232	3161.7	648	10532	3163.0	666
27	3831	3171.7	1756	6842	3173.8	2116	8200	3174.8	2245	10490	3176.4	2388

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

TOYAH CREEK

REEVES COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
1	1.10	3120.96	Approximately 1.98 miles northeast along Highway 290 from junction with Fort Worth Street in Balmorhea, 0.41 mile north along paved road to IH-10 overpass, 54' east of centerline of paved road and 24' south of centerline IH-10 east bound, east end of south guard rail, an "X" cut in bolt.
2	1.9	3124.90	Approximately 1.99 miles northeast along Highway 290 from junction with Fort Worth Street at Balmorhea, 25' northwest of centerline of Highway 290, 35' northeast of centerline of paved road, in east end of North culvert, an "X" cut in headwall.
4	BM 1 AG 5	3144.39	At the IH-10 east bound bridge over the Toyah Creek, in the upstream left bridge abutment, 6' lower than the highway, a brass disc stamped "American Geodetic Survey 1 AG 5".

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

TOYAH CREEK

REEVES COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
5	USC&GS BM V 452	3162.041	About 0.7 mile east along U.S. Highway 290 and SH-17 from Post Office at Balmorhea, thence north 100 yards along Pecos Valley Railway, 31' west of west rail, in line with row of power poles, 19' east of a fence, 13' east of centerline of ditch, 5' south southeast of rail that projects 3', 1 foot north of concrete witness post, in top of a concrete post 7 inches below surface of ground, and about 3' below tracks, a standard disc.
5	BM 1 AG 3	3162.47	About 0.76 mile northeast along Highway 290 from its junction with Fort Worth Street in Balmorhea to the driveway, going northwest, then 0.25 mile along driveway to Toyah Creek, in the dam crown, a brass disc stamped "American Geodetic Survey 1 AG 3".
5	1.8	3142.46	Approximately 1.56 miles northeast along Highway 290 from junction with Fort Worth Street at Balmorhea, 125' southwest of "Stop" sign, 25' northwest of centerline of Highway 290, in east end of north headwall of culvert, a chiseled "X".

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

TOYAH CREEK

REEVES COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
10	BM 1 AG 3	3162.47	About 0.76 mile northeast along Highway 290 from its junction with Fort Worth Street in Balmorhea to the driveway, going northwest, then 0.25 mile along driveway to Toyah Creek, in the dam crown, a brass disc stamped "American Geodetic Survey 1 AG 3".
10	USC&GS BM U 452	3191.103	At Balmorhea, 133' west northwest of west corner of Post Office, in top of north corner of concrete and stone foot bridge over a small pond, 41' southeast of centerline of US Highway 290 and SH-17, 49' southwest of 12 inch spruce tree, in small narrow park, 3" southwest of stone guardrail and about 1½' above level of highway, a standard disc.
10	BM 1 AG 2	3193.54	Approximately 0.12 mile northwest along FM 2093 from U.S. Highway 290, at bridge on FM 2093 over Toyah Creek, in left end of downstream side of bridge, a brass disc, stamped "American Geodetic Survey 1 AG 2".

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

TOYAH CREEK

REEVES COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
11	USC&GS BM U 452	3191.103	At Balmorhea, 133' west northwest of west corner of Post Office, in top of north corner of concrete and stone foot bridge over a small pond, 41' southeast of centerline of US Highway 290 and SH-17, 49' southwest of 12 inch spruce tree, in small narrow park, 3" southwest of stone guardrail and about 1½' above level of highway, a standard disc.
11	BM 1 AG 2	3193.54	Approximately 0.12 mile northwest along FM 2093 from U.S. Highway 290, at bridge on FM 2093 over Toyah Creek, in left end of downstream side of bridge, a brass disc, stamped "American Geodetic Survey 1 AG 2".
12	1.4	3222.57	Approximately 0.45 mile southeast along Fort Worth Street from junction with U.S. Highway 290 at Balmorhea to intersection of Railroad Avenue, then 0.96 mile southwest along Railroad Avenue, 50' northwest of centerline of road, 24' northwest of fence line, an "X" cut in top of concrete canal conduit.

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

TOYAH CREEK

REEVES COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
14	USC&GS BM X 1115	3226.099	About 1.3 miles southwest along U.S. Highway 290 and SH-17 from Post Office at Balmorhea 58½' northwest of centerline of Highway, northwest of and across highway from small white farm house in line with north edge of dirt road east from highway, 27' southwest of telephone pole and in line with row of telephone poles, 14½' northeast of "T" fence corner, 1½' southeast of fence, 2' southeast of concrete witness post, in top of concrete post projecting 7" and about level with highway, a standard disc.
15	1.4	3222.57	Approximately 0.45 mile southeast along Fort Worth Street from junction with U.S. Highway 290 at Balmorhea to intersection of Railroad Avenue, then 0.96 mile southwest along Railroad Avenue, 50' northwest of centerline of road, 24' northwest of fence line, an "X" cut in top of concrete canal conduit.

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

TOYAH CREEK

REEVES COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
16	USC&GS BM V 1115	3277.884	About 1.45 miles northeast along U.S. Highway 290 and State Highway 17 from the Post Office at Toyahvale, in the top and center of the west concrete headwall of a culvert, 26' west of the centerline of the highway, 0.1 mile south of the junction of a dirt road leading east, on the inside of long curve with tangents northwest and southwest, 1½' above the highway shoulder, and about level with the center of the highway, a standard disc.
17	USC&GS BM Z1115	3259.580	About 0.15 mile southwest along U.S. BM Highway 290 and State Highway 17 from the Post Office at Balmorhea, thence 1.2 miles northwest along a graded dirt road, thence 0.95 mile west-southwest along a dirt runway, 175' south of the extended centerline of the east-northeast - west-southwest dirt runway of the Balmorhea Airport, 78 feet southeast of the centerline of a dirt road, 1½' northeast of a white wooden witness post, in the top of a concrete post projecting 6 inches, a standard disc.

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY
TOYAH CREEK

REEVES COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
20	USC&GS BM V 1115	3277.884	About 1.45 miles northeast along U.S. Highway 290 and State Highway 17 from the Post Office at Toyahvale, in the top and center of the west concrete headwall of a culvert, 26' west of the center-line of the highway, 0.1 mile south of the junction of a dirt road leading east, on the inside of long curve with tangents northwest and southwest, 1½' above the highway shoulder, and about level with the center of the highway, a standard disc.
21	USC&GS BM U 1115	3292.480	About 0.75 mile northeast along U.S. Highway 290 and State Highway 17 from the Post Office at Toyahvale, in the top and center of the southeast concrete headwall of a 4-channel concrete culvert, 25' southeast of the centerline of the highway, 0.2 mile southwest of a curve in the highway, about level with the highway, a standard disc.

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

TOYAH CREEK

REEVES COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
26	USC&GS BM T 1115	3368.750	About 1.35 miles west along U.S. Highway 290 from the Post Office at Toyahvale, in the top of the south end of a ledge on the east abutment of a concrete bridge over Toyah Creek, 18' south of the centerline of the highway, 5½' south of the southeast guard rail, 2' below the top of the abutment, and about 2' below the level of the highway, a standard disc.
27	BM 1 AG 1	3387.15	Approximately 1.21 miles southwest along U.S. Highway 290 from its junction with State Highway 17 to the bridge over Toyah Creek then, 0.38 mile upstream Toyah Creek, at the top of the spillway, in the north end of it, a brass disc stamped "American Geodetic Survey 1 AG 1".